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EDITORIAL NOTES.

Refractory Materials and Temperature Tests.

THE main object of the work of the Refractory Materials Committee has been to secure a better class retort material which will stand without fusing at a specified temperature. But what is this temperature? Is it the one mentioned in the specification, or some other temperature that is not mentioned? One does not know exactly what to think, in view of the fact that the Committee describe the difference between ordinary working temperatures and the temperatures named in the specification as the margin of safety, while an engineer who—working at temperatures below the specified one, and within the "safety" margin, using material ordered to comply with the specification—finds that he is melting-down his retorts is simply told that it is for him to decide whether it pays him to take the latter course. In such a position, the most obvious thing is that certainty is absent. There is no consolation to a man to have his complaint summarily dismissed when he has been hoping, by following the issue of the work of the Committee, to be able to increase his temperatures above what has hitherto been regarded as the normal. The margin of safety ought to have some material, and not visionary, advantage up to the final degree; otherwise there is no sense in calling it a margin of safety. That is the position at Waltham Abbey. There has been purchase of material to standard conditions, and fusion at working temperatures below those specified, but at which there is, according to the terms of the specification, to be "no sign of fusion." There has been a visit paid to the Waltham Abbey Gas-Works to ascertain, by personal inspection on the spot, what is happening there, and the substance of the ground on which Mr. W. B. Randall lays his complaint. The results of the visit are presented in an article in other columns; and we are compelled to adopt the conclusion that Mr. Randall has not complained without cause, and that his complaint is not exaggerated.

The only place where one can find room for a little criticism is that the tests of the temperatures at which he is working were taken by the Féry pyrometer, whereas the specification prescribes Seger cones. Now it is known that there is some difference between the readings of the Féry pyrometer and the indications of the Seger cones—the former are lower than the latter. A large number of comparative readings made in Edinburgh in January last year show this. For instance, from a tabulation of the results by Mr. W. R. Herring, we find that in one oven a temperature of 2480° Fahr. was recorded by the Féry pyrometer; whereas Seger cone No. 17 softened slightly, but retained its shape. This indicated a temperature of 2696° Fahr. No. 16 cone softened and turned over. Therefore, it may be taken that in those tests the difference between the readings of the Féry pyrometer and the indications of the Seger cone was 216° Fahr. To perhaps a small extent, the difference is affected by the cones being left in the setting twenty-four hours, whereas the Féry observations were made when the setting was open, and thus exposed to access of cold air. The reason the Féry pyromter was used for taking the temperatures of the settings at Waltham Abbey was because the Refractory Materials Committee suggested its use to obtain the temperatures required for their 1910 return. But Mr. Randall is well aware of the difference between Féry readings and Seger cone indications, for the National Physical Laboratory informed him that their results show that the softening points of certain materials, as measured by the optical pyrometer and Seger cones, may differ, apparently, by about 200° C. The reason the word "apparently" is used is because some of the difference arises from the difference in the scales of temperatures used. The National Physical Laboratory and the Edinburgh tests go to confirm one another. Other recent measurements also show the disparity between the melting-points given for the Seger cones and readings by the optical pyrometer. All the available evidence appears to indicate an unreliability on the part of the former. However—making allowance for the difference between the readings by the Féry instrument and the indications of the Seger cones—it does not by any means neutralize the case that the Waltham Abbey Gas-Works presents from experience against the refractoriness of retort material made under the specification of the Refractory Materials Committee.

It seems to us that this experience might be taken as the starting-point for an investigation of the greatest value not only to the Waltham Abbey Gas Company but to the gas industry generally, if the Institution could afford to place an investigation in the hands of an independent expert, and the Directors of the Company were willing for such an investigation to be made. For what Mr. Randall has done has been to take the specification at its word, and has had the boldness to exceed temperatures that other engineers have not yet attempted, despite the inducement of the standard temperatures. Of course, the Company are not in the position to have on their staff the requisite scientific ability for such a research; and therefore we do appear to have here a matter that should be followed up in the general interest.

Mr. Butterfield on the Hygienic and Heating Efficiencies of Gas-Fires.

IT is believed that we are now getting to the final stage of the controversy on the hygienic and heating efficiencies of gas-fires. The importance of the subject in relation to the future of gas-fire construction and use is a sufficient justification for the time and space that have been devoted to its consideration. It will be remembered that the Davis Gas-Stove Company unreservedly placed in the hands of Mr. W. J. A. Butterfield, M.A., F.I.C., the question at issue between them and Messrs. John Wright and Co. regarding the effect (if any) upon heating efficiency of constructing a fire that will pass the whole of its products of combustion through the flue-vent without the aid of a length of flue-pipe. The end of the first part of Mr. Butterfield's investigation has been reached; and just as unreservedly as those who consulted him placed the matter in his hands for investigation, so unreservedly, notwithstanding his "fiduciary "position" to the Davis Gas-Stove Company, has he placed before our readers, in a fashion both useful and instructive to all, the lines of his investigation and the results. The whole course of the investigation and the results are set out in a manner that anyone can understand. Instead of giving relative percentage figures based on a standard composed of results from a fire without flue-pipe attached, and which admittedly (if there is any value to be placed on the words that provoked this controversy) in that condition passed hot products of combustion beneath the canopy, Mr. Butterfield has taken two representative fires of the two parties to this dispute, and has given to the gas industry the actual findings, in both total figures and percentages, in relation to the tested calorific power of the gas consumed. This fact alone is of considerable value in a controversy which appeals to such a large number of engineers and managers who prefer to have matters of this kind presented in a plain, practical way. We need not speak in our pages of Mr. Butterfield's competence for the work, nor of the care that he exercises and independence he asserts in such work, and which have established such marked confidence in any investigation he undertakes. With his present article before us, our conviction is strengthened that the principle, regarding an absolute hygienic efficiency without the aid of a flue-pipe as advocated by the Davis Gas-Stove Company, and supported by certain other makers both in practice and in their writings in our columns, will become, by force of the compulsory requirement of the gas industry, a commonly applied one among the makers of gas-fires.

The lines of the reference to Mr. Butterfield were laid down by Messrs. John Wright and Co., by their now famous

contention of last autumn, that "a fire that carries off its "products without being attached to a flue will, when the "*ordinary* chimney draught comes into play, inevitably carry "off more than the products—to wit, an unnecessary num- "ber of heat units as well—and a lower room-heating effi- "ciency is the result." Now Mr. Butterfield having tested a Davis "Apollo" fire which will pass all its products of combustion through the flue-vent without a flue-pipe, and a Wright "Mascot" fire which does not pass all its products through the flue-vent without a length of flue-pipe attached, says, as plainly as is necessary, and his figures show this more clearly than any others so far published, that (with these two representative fires, and under the described conditions) the generally applied assertions contained in the quoted statement have no foundation in fact—that it is not "inevit- "able" that more heat units will be carried away up the chimney with a gas-fire hygienically perfect without a flue-pipe connected than with a gas-fire that is only hygienically perfect with a flue-pipe attached, nor will a lower room-heating efficiency result from the former. This can be clearly shown by giving relief here to the conclusions of the investigation. The tests in the case of both fires were first made without a flue-pipe connected, and then with varying lengths of flue-pipe, though a flue-pipe is unnecessary with the Davis fire. As to heating efficiency, Mr. Butterfield says that the results of his tests, as set forth in the tables, distinctly show that the fire constructed to the hygienic principle laid down is certainly not inferior in radiation efficiency to the other fire examined, even when a strong chimney draught is applied to the flue-vent; while the total heating efficiency is about the same. Concerning the temperature and the carbon dioxide content of the flue gases, although these are shown to be higher with the Davis "Apollo" than with the Wright "Mascot" under the same conditions, the remark upon this that Mr. Butterfield makes should be particularly noted in order to avoid confusion. It is that the volume of flue gases is correspondingly less with the "Apollo" fire than with the "Mascot;" and that consequently there is no greater loss of heat by way of the flue under most conditions with the former than with the latter. In these two points, we have the complete negative to the Wright "to wit" theorem.

The fourth table in the article, which shows the distribution of heat per cubic foot of gas consumed, is one of the clearest compilations that has yet been presented bearing upon this subject; and, if this does not help to clear away assumption and erroneous beliefs, we do not know what will. It shows clearly that a fire which, constructed in the manner of the one tested, will pass all its products through the flue-vent without a flue-pipe attached, is rather more efficient in the matter of heat given to the room than the other fire from no flue-pipe up to 4 ft. 9 in. of flue-pipe, and there is no appreciable difference when a further 2 feet length of flue-pipe is attached—making a length of 6 ft. 9 in., which is never used in practice, but which length has been requisite in the past in certain cases to overcome the passing of products under the canopy. Therefore, there are, as Mr. Butterfield points out, no grounds for the fears expressed that reduced heat efficiency will necessarily result if gas-fires are constructed so that, when unaided by flue draught, they discharge the whole of the products of combustion through the flue-vent. In other words, the gas industry can have the hygienic efficiency represented by fires which will, under normal conditions (without assistance of a flue-pipe), pass the whole of their products of combustion through the flue-vent, without suffering loss of heating efficiency, and which fires, though a length of flue-pipe be fixed without detriment to heat efficiency when installed, do not rely in any degree upon that flue-pipe for hygienic efficiency. This is the lesson of Mr. Butterfield's investigation; and the gas industry will benefit from it.

In this controversy, we have been accused of partisanship. We think the independence of the "JOURNAL" is sufficiently well known to have caused any accusation of the kind to be passed by with the derision that it deserved. Whatever partisanship we have shown has been for a principle, and not for a firm. At the same time, it is only right to say now that, even though other makers were prior to last year doing what the Davis Gas-Stove Company have advocated in regard to hygienic efficiency, the stand they have made, and the open steps they have taken, through an independent expert of high attainments in gas chemistry and of large and diversified experience in the testing of gases and air, to prove the accuracy of their methods, have done much to establish a new principle which will have influence upon gas-fire construction and upon public confidence in the use of such fires.

Sulphate of Ammonia Manufacture.

THERE is interesting and instructive reading in the annual report of Mr. W. S. Curphey, the Chief Inspector under the Alkali, &c., Works Regulation Act, for sulphate of ammonia manufacturers, as well as for those who are in the position to be makers, but who waste the crude liquor in, for these days, a lamentable fashion. The work of the department does not decrease; for its province is among progressive works and multifarious developing operations. There was only a small increase during 1912 in the number of sulphate and muriate of ammonia works and gas liquor works; but with the great coal strike and attention so largely diverted to other matters during the year, the contrary could hardly have been expected. The first matter claiming consideration is the effect that the coal strike had on the production of sulphate of ammonia. Estimates by Messrs. Bradbury and Hirsch at the close of the year suggested the anticipation that, while the loss in production during the strike had been largely counterbalanced by the activity that ensued in the second part of the year, there would be found a shrinkage on balance of about 6000 tons. At the time we rather questioned this; and the later figures that Mr. Curphey supplies point to an increase, instead of to a decrease, of 3332 tons, in comparison with 1911. As a matter of fact, gas-works, according to these later statistics, instead of presenting a decrease of 3000 tons as foreshadowed, can claim to have contributed an increase to the extent of 3311 tons, while shale-works came out at the end of the year with an increase that about compensated for the reduction on coke-oven and producer plants. This is more in accord with our own expectations, on the same ground that Mr. Curphey advances in the remark that "the decided increase in the [sulphate "of ammonia] production of gas-works is one result of the "preparedness in so many gas-works to meet the demands "for gaseous fuel at a time when the price and scarcity of "solid fuel turned consumers' attention in other directions." Thus we find that the total of 388,308 tons of sulphate in the report before us is more than Messrs. Bradbury and Hirsch's estimate by 9308 tons, which represent the shrinkage they predicted and the increase of 3332 tons which Mr. Curphey actually finds. But this must not be regarded as any censure on the earlier estimates; for it is astonishing that, before a new year has scarcely commenced, the firm mentioned are able to present estimates of production that usually very closely approximate to the later ascertained actual figures. However, when we come to the current year, we shall be surprised if gas-works do not show a still greater advance in production; for, despite the higher price of coal, oil is at such a figure now that many carburetted water-gas plants are idle, and there has been a larger dependence on coal carbonization. Gas-works would be glad indeed, at the present time to find the price of oil slipping back to its old figures; for there is little compensation to them, in comparison with the drawbacks to them of high oil prices, in other people having to pay stiffly for the liquid commodity. As the First Lord of the Admiralty remarked on Thursday last, when dealing with the question of liquid fuel for the Navy, the "open market" now is an "open "mockery."

That in passing. The Chief Inspector still finds it necessary to administer a little rebuke concerning the loss of ammonia in handling and storing ammoniacal liquor; and more attention to this—a point to which Mr. J. T. Sheard drew prominent notice in his Manchester University Lecture in 1911—is one of the urgent considerations in gas-works economy. But there is another matter to which reference is made by Mr. Curphey with regret; and in relation to the point, it would have been valuable if the report, and the contained expressions of opinion in this regard, had been available at the time of the chemical clause inquiry. The point is the great waste that goes on in connection with small gas-works in discharging ammoniacal liquor into the sea, or in otherwise disposing of it. "The loss," says Mr. Curphey, "throughout the country as a whole must be very "considerable." There is no need in these days for such great waste. It is not now a question of works compulsorily sending their liquor long distances to chemical manufacturers. The nearest neighbouring gas undertakings that manufacture sulphate of ammonia can absorb the liquor of

their less affluent neighbours; and, moreover, there are suitable sulphate of ammonia plants available to-day for very small producers of liquor. Dr. Fryer, the District Inspector for the South and South-West of England, makes a special point of this waste by small gas-works. In his area, there is a coastline of no less than 600 miles; and it is rather a reflection upon progressiveness in manufacturing management that he should be able to write: "At the "present time many of the small gas-works, and some of "even larger output, turn their gas liquor direct into the sea "without any attempt at utilizing it as sulphate of am-"monia." He also comments upon the waste by those works in country districts that, on account of carriage, turn the liquor to waste. This is to be seriously regretted now that small sulphate of ammonia plants (such as Mr. Phillip Moon introduced in a paper at a meeting of the Southern Association in 1910) can, as has been fully established, be profitably operated. Dr. Fryer urges the managers of small works to consider this question; and he further advises those who already have small plants in operation to see that they are obtaining the maximum possible from them, under their working conditions. In papers before our District and Junior Associations, attention has been called to avoidable loopholes for loss in the working of small plants —such as the irregular injection of cold milk of lime into the still by hand pumping, which allows the fixed ammonia to be lost by passing into the effluent without liberating the ammonia. Simple methods have been devised—such as that described by Mr. F. Shewring in his address to the Midland Juniors in 1912—by which a regulated and fairly continuous feed can be ensured in the still, with a resulting improvement in the quantity of sulphate of ammonia produced per ton of coal carbonized. Other points are mentioned by Dr. Fryer, as will be seen when we publish the relevant parts of his report next week.

The Chief Inspector has nothing special to announce regarding the adoption of the "direct" processes of sulphate of ammonia recovery. Their chief application has been in connection with coke-oven working; but he does say that where such plant was in use in gas-works prior to the year under review, it has continued in satisfactory operation. There is careful watching on Mr. Curphey's part of the attention that is being directed to the formation of a commercial salt of ammonia from gas containing ammonia and sulphuretted hydrogen without the intervention of sulphuric acid; and there will be agreement with the hope he expresses that an effective method will be devised. During the year there has been further investigation of the subject of the action of oxide of iron during fouling and revivification; and for this work Mr. Linder has been largely responsible. The portions of the report bearing upon it are reproduced this week; and they may serve for subsequent comment upon further consideration.

Retort Temperatures, Material, and Construction.

THE paper read by Dr. Karl Bunte at the meeting of the German Association, on the technical development of the heating of retort settings [*ante*, p. 171], is constituted of a number of carefully arranged reflections on the subject. In considering the possibilities of further advance in gas productivity, he correctly names the heating arrangements of retort-settings as being the centre to which we must look for that advance, and for effecting further economies. Advance reposing principally in the heating arrangements, the question of the constructional material is really the controlling factor; and this Dr. Bunte recognizes by his reference to a material being required which will offer greater resistance to high temperatures and an increased conductivity. He mentions in this connection carborundum, which has been used for furnace-linings; but he does not directly refer to what is being done in America with silica material and (of course, this was not then within his knowledge) the work which is now privately under-way in this country, and which was referred to by us last week. According to the translation of the paper, he does not indicate another necessary factor in this question of retort material for higher temperatures—that is, that it will resist deterioration under rapidly varying temperatures, such as are occasioned by the re-charging of retorts and by the admission of cold air to them.

There is a fresh consideration bearing upon the character of any new material introduced for the construction of retorts; and it is that the newer systems of retorts extend the scope of the properties of the material that may be applied. In the building of vertical retorts and coke-ovens, they are carried upwards from a solid foundation, so to speak; and they are not dependable for support in the same way that a horizontal retort is. This being so, it is conceivable that material of high temperature resistance, and not subjected largely to deterioration from temperature variations, which may not be good for horizontal retorts, may prove all that is good for vertical retorts. This also bears upon the question of brick-built retorts. In the recent attack upon the Woodall-Duckham retorts in our German contemporary, a question was raised as to their tightness, in comparison with moulded fire-clay retorts; and the point was easily disposed of, as it was obvious that the critic did not understand the structural features of these retorts. From various works in this country, there come excellent reports as to the durability and working of brick-built horizontal retorts; but the facility with which repairs can be effected with them always makes one somewhat doubtful as to the longevity records that are presented, as, under the circumstances, there is some difficulty in knowing which is the new and which is the old part of the retorts. But if there is a form of retort that is suitable to brick construction, it is the vertical one, on the ground already mentioned, that it is built up from a solid foundation, and therefore does not have to rely upon the support that is requisite in the brick form of horizontal retort. If the criticism in our German contemporary had been levelled at horizontal brick-built retorts, we should not have been so confident in defending them as in the case of the vertical retort. The point is one on which Mr. W. R. Herring submits some useful experience in our "Correspondence" columns this week.

To higher temperatures we have to look for further advances; and, as we say, material is a controlling factor in the use of these temperatures. But the vertical construction of retorts and coke-ovens gives greater scope for the investigation of materials. Dr. Bunte shows the work that has been done in producing a higher heat efficiency in retort-settings, and indicates the seats of the loss of heat, where work may produce further economy. The more the heat can be conserved in retort-settings, the lower the fuel account, though it may be profitable to raise this account somewhat to produce a greater yield per ton of coal carbonized. In dealing with outside independent producers, Dr. Bunte does not consider the application of the ammonia-recovery type, as introduced to notice (in a practical application to gas making) in Mr. W. Chaney's paper at the recent meeting of the Institution of Gas Engineers. If Dr. Bunte had been reading his paper just a little later, he might have increased its interest by a reference to this point, and by dilating at greater length on retort material. There are signs of movement in connection with gas-works carbonization operations which we hope will result in the production of something of material advantage.

Railway Rates on Coal and Coke.

In dealing recently with the question of the increase of railway rates on merchandise—in connection with the Act giving the railway companies the right to recoup themselves from goods traffic for the increase of wages and betterment of the conditions of railway labour—it was pointed out that no notification had then been made of an advance on coal and coke, except in the case of Scotland. An announcement of an increase has not been long coming in respect of coal and coke from Derbyshire and Nottinghamshire. Eight railway companies have intimated to the colliery proprietors in these areas an increase of from ½d. to 3d. per ton according to destinations—the advance to take effect as from September next. The "Iron and Coal Trades Review," in referring to the increase, fears that, though it is not general, it is but the thin end of the wedge. Should this fear prove true, it simply means a piecemeal application of the additional rate. If the burdens on raw material are to continue to increase in this manner, then it cannot be long before a vigorous whittling-away of the prosperity of the country sets in.

Sulphate of Ammonia Committee.

The Sulphate of Ammonia Committee have been at work sixteen years; and the principal portions of their report for the last year of the sixteen appear in our columns to-day. The report supplies in concentrated form an account of the activities

of the Committee; but what is read there really gives a very inadequate idea of the vast amount of detail work that is entailed by what is done, and done so successfully. No amount of individual endeavour could accomplish what the Committee have done, and are continuing to do. There is, in fact, no *ad hoc* organization of which we know that excels this one in satisfying the subscribers of the genuineness of its work and of the necessity for it. The surprise is that there is a single undertaking of any description producing sulphate of ammonia with its name still missing from the register of the Committee. This is essentially a case in which demand only can maintain a good level of price; and demand can only be created by convincing of the value of sulphate of ammonia in comparison with competitors those whose business it is to increase the fruitfulness of the land. During 1911, the home consumption of sulphate of ammonia increased by about 10,000 tons, and in 1912 by a further 8400 tons—making an increase in the two years of about 18,400 tons. The Committee have a perfect right to regard this as very gratifying testimony to the value of the extensive system of field plot work carried on under their auspices throughout the country. This form of propaganda brings the Committee into close personal contact with large numbers of farmers, and enables them to demonstrate to them in the most convincing manner, and on their own land, the beneficial results to be derived from the proper use of sulphate of ammonia. The Committee continue very active in this work, as well as in the distribution of fresh literature; and they take their part with other organizations abroad in efforts to extend the radius of application and consequently of demand of the commodity.

A Word to Non-Subscribers.

This is a particularly convenient time for making special appeal to those of our readers—those in charge of gas undertakings and owners of coke-oven and gas-producer plants—who are non-subscribers to the Association. Last year there were additional subscribers enrolled from the coke-oven and iron industries representing 8500 tons of production, and from gas undertakings representing only a further 700 tons. The present situation should claim the attention of those who are still withholding their support from the work, because sulphate of ammonia producers cannot possibly allow market values to take a downhill course without doing everything that is possible to prevent further slip. This is vitally important at the present time. Here we see a substantial increase in home consumption; and yet prices have fallen somewhat from their high level. Therein is the strongest possible reason for all producers being in line in the endeavour to keep the shrinkage of prices within narrow bounds, and, if possible, to turn them in the direction from which they have descended. Here in the gas industry we have dearer coal and oil, and a coke market in a position that is not by any means agreeable. Other materials have also gone up in price; and labour charges and railway rates have advanced. This being so, everything must be done to preserve at their best such sources of revenue as sulphate of ammonia. Therefore, the Committee should be invested with the means to work with maximum energy and to maximum efficiency. If, through the Committee, demand is sufficiently stimulated to enable consumption to keep pace with ever-growing production, remunerative prices will continue to be obtainable; and we know of no other means by which they can be maintained. We hope that this remark will be seriously pondered by non-subscribers.

A Weekly Rest-Day.

A further proposal for State regulation of labour is contained in a Bill which has been introduced into Parliament, and was down for second reading last Thursday. The title is the Weekly Rest-Day Bill; and the object aimed at is to amend and consolidate the Acts relating to Sunday employment, and to regulate the conditions of labour upon the basis of six working days in the week, with Sunday as the normal weekly rest-day. There are fourteen clauses and three schedules; one of the latter giving a list of the seventeen Acts the provisions of which would, in whole or in part, be affected on the measure becoming law. Heading the names of those by whom the Bill was ordered to be brought in is that of Lord Henry Cavendish-Bentinck. The majority of the fourteen clauses referred to embrace the necessary machinery for carrying into effect the intention of the Act, which, generally speaking, is to render Sunday employment unlawful, both for a person who is himself carrying on an occupation and for those employed by him. Shops, to which the principle is applied, have a clause to themselves. Of course, there are exceptions to the rule laid down. In the first place, certain occupations of necessity or mercy (as set out in the schedules) may be carried on, either continuously or during limited hours, on Sunday; and there are also others which may only be carried on during limited hours, and under the order of a local authority. Among the former is noticed "the maintenance and cleansing of sewers, or any work without the doing of which on Sunday electric current, light, heat, cold air, water, or gas cannot be continuously supplied for lawful purposes," and "any unavoidable work of persons employed in domestic service," &c. A number of the other exceptions deal with medicine, food and drink, newspaper work, and transport. Exemption may also be granted by local authorities to Jewish shopkeepers who habitually treat Saturday as the weekly rest-day—provided their assistants and the customers served are also members of the Jewish community. Again with some exceptions (including persons employed in domestic service), it is provided that in cases of employment on Sunday, an equivalent period of rest shall be given within the week, and that no person shall be employed on more than twenty-six Sundays in the year. What, one wonders, would "unavoidable" Sunday work for persons in domestic service consist of? Since this note was put in type, however, need for further speculation has been removed by the official announcement that the Bill has been dropped.

The Schemer and his Reception.

Dr. C. H. Leibbrand is, we see from the local papers, still contributing greatly to the gaiety of East Anglia by his visionary schemes. He believes that he holds the salvation of the Eastern Counties in the hollow of his hand, if people will only accept him and his projects at his own valuation and on his own terms. It will be remembered how he proposed to convert Harwich into a great commercial seaport, and how his schemes included a project for an extensive electricity supply scheme, of which the Felixstowe electricity undertaking was to form the nucleus. He could not, however, get the Urban District Council to foot the bill for a valuation of the electricity concern, which the Doctor was hoping to secure on behalf of the Company that he has in view. In consequence, the magnates of Felixstowe have incurred the wrath of the Doctor. He has held in the town a meeting which is correctly described in the Press as having been of an "unusual character." He aired his views on the question of the development of the district, and made an attack on certain of the men of Felixstowe, who (unlike their critic) have helped to make it what it is. The reason for the attack seems to be the broad-minded way in which the Council deal with questions affecting both the Gas Company and the electricity supply concern, without according favouritism to the latter in view of the considerable stake that they hold in it. Dr. Leibbrand is apparently one of those whose mental view is largely limited by the importance of his own concerns; and therefore he cannot see that the interests of a town and its ratepayers should be considered quite apart from municipal trading, direct or indirect.

Gas Director as Councillor.

The Doctor considers that there is something antagonistic between the interests of the ratepayers of a town and the interests of a gas company, and that a councillor who is a gas director cannot serve in the two capacities, without the interests of ratepayers and gas company coming into conflict. He believes, in short, it would require a wonderful character and brain to keep the "diametrically opposed obligations conscientiously apart." As we construe his speech, Dr. Leibbrand stands as an advocate of the doctrine that local government should be dominated by municipal trading; and if that is not diametrically opposed to freedom in local government, we do not know what is. As a matter of fact, the interests of the ratepayers of a town and of a gas company (the latter being large ratepayers), especially a sliding-scale gas company, are absolutely identical, and not in any way antagonistic; and there cannot be better men to look after the interests of ratepayers than those who are local representatives on the board of a gas company. They have more genuinely at heart the interests of the town than men who, like Dr. Leibbrand, come among them from a distance for the purpose of seeking local favour and support for schemes, their

primary concern in which is probably not altogether personally disinterested.

Councillor as Electricity "Director."

But when the Doctor talks of the hostility of the positions of councillor and gas director, his ignorance of the tendency of municipal trading in local government projects rather acutely. In some districts where there is municipal trading in electricity supply, huge capital expenditures are incurred in converting public street lamps from gas to electricity. In the interests of the ratepayers? No; in the interests of the electricity concern! The educational committees spend ratepayers' money on the conversion from gas to electricity of the little-used lighting arrangements of school-rooms. In the interests of the ratepayers? No; in the interests of the electricity concern! Where councillors are on boards of guardians, the lighting arrangements of workhouses and infirmaries are sometimes converted from gas to electricity. In the interests of ratepayers? No; in the interests of the electricity undertaking! The interests of the electricity undertaking are not by any means those of the majority of ratepayers, as the excessive expenditure incurred for no tangibly improved result shows. Dr. Leibbrand takes a singular and very narrow view of things; but probably his vision has been affected by the seven years' street-lighting gas contract the Felixstowe Council have entered into—in the interests of the ratepayers. Dr. Leibbrand's nature is excellently portrayed by his references to one or two estimable local gentlemen, and to India's silver purchase and the Marconi "scandal."

An Active Commercial Committee.

Commerce looks as though it will in future be able to obtain a better hearing than formerly in the House of Commons. The newly constituted Commercial Committee, the Chairman of which is Sir John Randles, has become distinguished by numbers, and it will carry influence. Something like a hundred members of Parliament have joined it. It is hoped that some of the members of the House associated with the gas industry have found their way into this potentially useful body. Among the subjects that the Committee have under consideration are the working of the Patents Act and the increase in railway rates. The Patents Act at one time showed a large amount of promise, in the way of bringing new industry to this country; but it has all died away, and things appear to have drifted to the *status quo ante*. The President of the Board of Trade has acknowledged to Sir John Randles that he is impressed with the necessity of reform; but Parliament is in no mood for taking up any fresh legislative matters this session. The effects of the terribly protracted session of 1912-13 are still visible in the House; and members are very much inclined to play truant even at this stage of the session. Nothing but divisions on measures of first-class importance to the Government will bring together a fairly full and representative House. Therefore, nothing can be done this session; and so a Sub-Committee of the Commercial Committee are going to collaborate during the recess with the Manchester Chamber of Commerce in drafting an amending Patents Bill. In regard to railway rates, the Commercial Committee have decided to support the action of the Associated Chambers of Commerce. This was a subject that was referred to last week.

Trade Unionists and Co-Partnership.

The steps taken by Sir William Lever at Port Sunlight to improve the conditions of life of the employees are matter of common knowledge; and his belief in co-partnership is equally well known. In discussing the latter principle with the workers recently, he made it clear that he does not approach co-partnership from the point of view that employees have a right to share in the profits. This is no more his opinion than that the man who makes a saw or a hammer has a right to share in the profits of the man who makes articles with this saw or hammer. What he does maintain is that there is certain wealth being produced in the country by the joint labour of the workers and those who direct them, and he knows of no possible way except co-partnership by which the joint product of these forces in a productive enterprise can be appropriated among all. He, however, puts the matter on an even higher plane; for he says it is not a question of a right to share in the profits, but one of relationship between humanity, of flesh and blood, of human sympathy, and the conditions under which it is best to work together. It would be thought that such a proposition would be unanimously approved by those to whom it was intended to apply. But evidently this is not the case; for Sir William went on to announce that he was told by trade unionists, who were perfectly sincere and loyal to the men they represented, that co-partnership interferes with the solidarity of labour, and that the firm could only give this benefit on terms that made it impossible to do so. Therefore, though he took pains to make it clear that he has no objections to his employees joining a trade union, he has been compelled to state that he cannot isssue any more partnership certificates to trade unionists, or to members of a trade that is organized as a union, until the trade unions tell him how he can carry out their wishes without destroying co-partnership, or unless they withdraw their demands. Thus it would seem that those in control of the unions prevent members from getting that improvement in position which such bodies might be fairly expected to endeavour to secure for them.

PERSONAL.

Mr. Charles F. Brown, the Deputy Water Engineer and Surveyor at Gainsborough, has been appointed, out of 84 applicants, Water Engineer, Surveyor, and Inspector to the Leiston (Suffolk) Urban District Council.

In last week's paragraph referring to the wedding of the daughter of Mr. James Stewart, the name of the bridegroom should have been given as Mr. Albert Allen Catchpole, the eldest son of Mr. Edward A. Catchpole, of Grove Park.

Out of 64 applications for the post of Chief Assistant to the Aldershot Gas, Water, and District Lighting Company, a short list of seven candidates was prepared, and from this Mr. Charles M. Wilson, of Greenock, has been appointed.

In response to the invitation which appeared in the "Journal" for the 17th ult., there were 47 applications for the position of Gas Manager to the Newry Urban District Council. The appointment has been conferred upon Mr. Percival B. Ellacott, who is at present the Manager of the Warrenpoint Gas-Works.

Mr. J. E. Kenshole, the Manager of the Merthyr Tydfil Gas-Works, has lately been presented by the staff and workmen with a silver fruit and jelly stand, on the occasion of the celebration of his silver wedding, and in testimony of the high esteem in which he is held by the entire staff. When acknowledging the gift, Mr. Kenshole expressed the hope that the existing good feeling might long continue.

We learn that Mr. J. Paterson, the Manager of the Queenstown Gas-Works, will succeed Mr. John G. Tooms at Waterford. Mr. Paterson entered the gas profession under Mr. William Ewing at the Hamilton Gas-Works; and in 1897 was appointed Manager of the Carrick-on-Suir works. He soon afterwards went to Tipperary, where he remained five years. On the Queenstown works coming into the hands of Messrs. George Anderson and Son in 1903, Mr. Paterson was entrusted with their management, and has since carried them on with much success. He is a member of the Institution of Gas Engineers and of the Irish Association, and was President of the latter two years ago.

OBITUARY.

The death occurred last Wednesday, after an operation, of Mr. James Cloudsley, J.P., a leading member of the Corporation of London, Deputy-Alderman of Langbourne Ward, and one of His Majesty's Lieutenants for the City of London. Deceased, who was in his seventy-seventh year, was the head of the firm of Messrs. Williamson, Cloudsley, and Co., wholesale tea dealers, and was a Director of the Tottenham and Edmonton Gas Company, as well as of other companies.

Gaslight and Coke Company's Dividend.

We are informed by the Secretary of the Gaslight and Coke Company (Mr. Henry Rayner) that the accounts of the Company for the past half year show that (subject to audit) the balance to the credit of the net revenue account will enable the Directors to recommend the payment of a dividend at the rate of £4 17s. 4d. per cent. per annum; carrying forward to the next account the sum of £710,551 15s. 8d. The dividend for the first half of the past year was at the same rate, with a balance of £768,407 18s. 2d. carried forward; but for the year 1911 it was £4 14s. 8d., with a balance of £699,350 carried forward in June and £726,747 in December. For the June half of 1910, the dividend was at the rate of £4 13s. 4d.; while the carry-forward (including a balance of £32,746 taken over from the West Ham Company) was £542,370.

Mr. Trotman Foster, partner in the firm of Foster and Co., of 21, John Street, Adelphi, who died on April 20, aged seventy-one, left estate of the gross value of £49,102, of which £37,898 is net personalty.

NOTES FROM WESTMINSTER.

OVER the work of the Parliamentary Committees, one has to keep a very sharp eye, as there are times when there are what may be termed side-issues of importance to the gas industry from Bills which have not been promoted directly by gas undertakings. There were instances of this in the past week.

Government Competition.

The Gaslight and Coke Company and the London Electricity Supply Companies were shoulder-to-shoulder in the Committee rooms last week, and were jointly represented by the leader of the Parliamentary Bar, Mr. Balfour Browne, K.C. When a Government Department proposes to do something which will deprive the gas and electricity companies of a large consumer, and so create something which is tantamount to competition with them, it is time for the two interests to form in line in offering resistance. The case was plainly set forth in the evidence given by Mr. D. Milne Watson, the General Manager of the Gaslight and Coke Company. The Postmaster-General has a Bill in Parliament to authorize an expensive (and some people think an altogether unnecessary) scheme for a tube railway all of his own for the transmission of mails and other Post Office goods between the west and the east of London. He wants to work this railway electrically, and to generate his own electrical energy for the purpose. Then he was proposing to take general powers for using the current for any purpose in Post Office buildings, without any restriction as to the location of the buildings. The Gaslight and Coke Company have a big account with the Post Office, running into many thousands of pounds a year; and naturally they do not wish to be deprived of such a customer. For the Government to start using public money (largely found by private enterprise) for competing with, or curtailing the field of, private trading must surely be about the last straw. The Government representatives saw that the indefinite character of the proposal so far as Post Office buildings were concerned would not be regarded with favour; and so they offered to restrict the scheme to the supply of electrical current to Post Office buildings along the line of the new tube route, and, in the event of extensions of these buildings "across the street," to such extensions. This, too, was rather indefinite; and in the result, a limitation was agreed to confining the supply to Post Office buildings along the line of the tube, and within 50 yards of it. This will give the Post Office a fairly considerable scope; but it is better than the original proposal.

Electrolytic Action.

The Postmaster-General, always so ready to obtain protective clauses on his own account, is not so willing to give them when he is the person with a scheme that holds within it the possibility of serious interference with other interests. For instance, he is ever anxious to get the model clause inserted in electrical measures dealing with electrolytic action and damage. Under the model clause, if electrical undertakings—electricity supply or traction—carry out their works in accordance with the Board of Trade regulations, they are not liable to damages if injury results from their operations. No damage can be claimed, except in case of default. But the Postmaster-General says it is unusual for one Government Department to be subject to another. The reason is not transparent. Is it regarded as *infra dig.*, or what? A little light on the point would be of interest, if not convincing as to the legitimacy of the understood rule. However, there seemed to be a flow of sympathy between the Committee who considered the Bill and the Post Office Department; and they would not allow such an enormity as one Government Department being placed under regulations formulated by another. It seems a silly idea that a Government Department should be immune from the ordinary authorized regulations any more than semi-public concerns such as electricity undertakings. The Gaslight Company considered that, if the Post Office did not accept the Model clause, the Department should be subject to damages for injury whether or not they had taken precautions. However, what has happened is that the Post Office has now adopted a clause placing upon the Department the obligation of taking reasonable precautions. If reasonable precautions are not taken, then there is to be liability for damages. In electrically generated accidents, it often happens that the traces of whether precautions have been reasonable or otherwise are effectually expunged. Other protection was given to the Gas Company in respect of alteration to their mains and pipes; and an ordinary tube railway clause was inserted placing a penalty upon the Postmaster-General to the extent of £10 an hour in the event of any cessation of supply of gas through interference with the Company's mains. There was ineffectual resistance to this. The appearance of the Gas and Electric Companies before the Committee has thus been productive of some good, in the matter of limiting the incidentals of the Post Office scheme. So far as they were able, the Gas Company did well.

Middlesbrough and Out-Districts.

The curious position in which the Middlesbrough Corporation and the South Bank and Normanby and North Ormesby Gas Companies jointly figure, has not been entirely relieved, but partly so. In the districts named, the Middlesbrough Corporation have ancient unexercised gas-supply powers; but they could not lay mains in Ormesby without the consent of the District Council. Now they are asking to absorb into the borough the districts in question, and to extinguish the present local governing bodies. In this event, they would be placed in a better situation to revive the old powers, and to compete with the gas companies who had befriended the two districts, or to gain some advantage over them in the event of purchase. However, during the proceedings on the Extension Bill, the Corporation have shown that they did not want to act oppressively towards two small Gas Companies; while, on the other hand, they did not want the Gas Companies to gain any advantage over them in excess of the current position. There was only one direction to which the conditions pointed, and that was purchase by the Corporation as though they did not hold powers of supply in the areas in question. As the days of last week passed, goodwill expanded; and the parties were able to agree to terms of transfer—the only sane way out of the trouble. But there then came a surprise for the Corporation, in an announcement by the Committee that they had not made out a case for the annexation of part of the area in which the South Bank and Normanby Gas Company operate. This being so, purchase of that concern might not be desirable, and might not be sanctioned. However, nothing has been definitely settled; but probably to-day we shall hear exactly what is going to happen.

Gas Opposition to Electricity Schemes.

It was a curious ruling that Sir W. H. Davies gave, as Chairman of the House of Commons Committee who were considering the Watford Corporation Electricity Order Confirmation Bill. The Order proposes an extension of the electricity supply area; and the principal claim of the Corporation to be allowed that for which they petitioned was that they had made a flourishing concern of the electricity supply undertaking. The Gas Company were in opposition; and perhaps there is no ratepayer better able to act as critic of the conduct of a municipal electricity concern than the local gas competitors. The representatives of the Watford Corporation kept whining about the fact that the Corporation were working under the Northumberland clause, so that the Gas Company ought to be satisfied. They also seemed very much afraid of the Gas Company making a too searching investigation into particulars. Of course, without the Company took this line, they would be altogether unable to show whether or not the Corporation Department was of the flourishing character that was represented, and upon which rested the claim for extended territorial authority. It was, however, made clear that the Company had prepared themselves for showing that the Corporation electricity concern had been conducted in a manner that reduced the Northumberland clause practically to a farce, and that the so-called prosperity of the concern was fictitious, by the manner of charging the public purse with heavy sums for street lighting and for public buildings, while the concern does not bear its fair share of rates. The Chairman ruled that these were not matters the Gas Company need go into. But, if not such matters, upon what are they to found a case? The ruling was not heavily charged with wisdom. The Gas Company, having thus been switched-off from the line of their case, retired from opposition; and probably they will be heard of again in the next House. If so, we may learn more about the constituent parts of their case.

ELECTRICITY SUPPLY MEMORANDA.

ELSEWHERE there appears a review of a book, by Miss May Little, on "Simple Electric Cookery." Therefore in the "Memoranda" this week, we will eschew reference to cookery subjects.

A Point Five Defined.

A cognate one, however, is tariffs, which is a constant source of discussion and worry to the professional men of the electricity industry. It has always been so, and it is likely to be still more so in the future. There is too much of the game of follow my leader in the adoption of tariff policy in the industry, and too little consideration paid to the factor of local conditions. What may be a success in the way of a tariff in one place may be an absolute failure in another case. Those electrical engineers who have become members of the Point Five Association have many critics among their peers outside their own loosely constructed pale. Any one who adopts, as a pendant to his existing tariffs, a fixed price per annum based on net rateable value, and 0·5d. per unit in addition, may become a Point Five, though the inclusive price paid by a consumer under this tariff may be somewhere in the region of the normal flat-rate per unit. Those engineers, however, who maintain the ordinary tariffs, and adopt ½d. per unit for cooking and heating, are probably doing a more senseless thing than the engineer who assures himself of a lump sum from each consumer under the alternative system. But in both cases, the new tariff hits hard at the lighting consumer on the ordinary rate, who contributes a larger profit per unit than the consumers whose custom runs on the other lines of payment. What the Point Fives say to the faithful lighting consumer under the old order of things is: "If you do not come under the new system, and suffer the inconveniences of using electrical energy for heating and cooking, then

we intend to make you pay dearly for following the dictates of your inclinations." Mr. A. Nichols Moore, the Borough Electrical Engineer of Newport, Mon., writes to the "Electrician" on the subject. He has been making a careful study of the tariff charges of the various corporations which the members of the Point Five Association have the honour to represent. The more he studies the matter, the more puzzled he becomes to know what does or does not constitute a "Point Five." We have shared his view from the very advent of this little band, whose strongest proclivity seems to be more in the direction of playing upon instruments of brass than in accomplishing any real good for their undertakings through the Point Five policy. The result of Mr. Moore's study of these human curiosities is that the proper definition of a "Point Five" is "anybody who is willing to sell electricity for cooking purposes at a loss." In the list of Point Fives published by the "Electrician," there is an asterisk which denotes an honorary member, while daggers denote "freshers." Mr. Moore suggests an additional sign to indicate "welsher."

Cooking Supply at 480 Volts.

It is stated by the "Electrical Times" that the Marylebone Borough Council have applied to the Board of Trade for sanction to connect cooking apparatus on consumers' premises at medium pressure (which in that district means 480 volts); and the Board of Trade have forwarded to the London County Council a copy of a regulation which it is proposed to prescribe in connection with such a supply. The Highways Committee of the Council, after consultation with the Special Committee on London Electricity Supply, are of opinion that it is desirable for the framework of the cooking apparatus to be earthed, and recommend that: "The Council are of opinion that the regulation proposed to be prescribed by the Board of Trade, under the St. Marylebone Electric Lighting Order, 1901, in regard to the supply by the St. Marylebone Metropolitan Borough Council of electrical energy at medium pressure for cooking purposes, should provide that the framework of the cooking apparatus itself, as well as the guard protecting the heating elements, should be efficiently earthed." Our contemporary does not suppose that the Marylebone Electricity Department would in any circumstances omit to earth the cases of all cookers connected to its 480-volt supply. Nor do we think the officials would be so foolish; but still it is easy to agree that it is as well perhaps for the practice to be endorsed officially. One never knows what madcaps may receive official appointments—later on.

A Point Five per Candle Power Lamp.

Periodically, there come rumours of metallic filament lamps that are going to cut down the wattage by a further substantial amount; but so much of this sort of thing has been heard that one feels quite content to sit complacently till the thing actually arrives. When the wire-drawn lamp first came on to the market, 1 watt-hour per candle power was advertised as the efficiency. Many tests have shown that not only is this untrue, but batches of the lamps in the hands of different observers have shown that the efficiencies generally vary from 1·3 to 1·5 watts and sometimes upwards per candle power. Not long ago it was announced that a lamp was about to be put on the market that was going to do the trick for 0·8 watt. But the heat of the lamp suggested over-running, and the over-running short life. The "Electrical Review" now says that the latest development in connection with a low watt consumption per candle power is reported from Germany, where the A.E.G. intends to introduce in the autumn a new lamp, which is claimed to consume only 0·5 watt per candle, as compared with 0·8 watt to 1 watt per candle of existing wire lamps. Our contemporary might have refrained from quoting figures that are not obtained even under the favourable running of the laboratory. However, it is further stated that the Incandescent Gaslight (Auer) Company, who manufacture Osram lamps, will also introduce one having a similarly low watt consumption. The figures, of course, refer to the Hefner "candle." It is time the Editors of the "Electrical Review" spoke of Hefner units, not "candles." No such thing exists as a Hefner candle.

Free Supply of Fittings, Lamps, &c.

It is our business to note new competition ideas. It seems that some builders who wire their new houses for electric lighting find that the innovation does not always please their tenants, who have an objection to paying for expensive electric fittings, lamps, and shades. The "Electrical Times" asserts that electrical wiring by builders is becoming the *usual* thing. This is an armchair statement that is not supported by fact in the world beyond the editorial sanctum; but, in effect, our contemporary also confesses that something more is wanted to induce the tenants to adopt electric lighting. That something is the accessories. The "Electrical Times" therefore suggests to progressive builders that they would find it worth their while not only to carry out the wiring, but to complete the installation—including lamps and shades. The idea is derived from what is being done by the Kinnaird Park Estates Company, Limited, at Bickley, Kent. The Amesbury Estate there is being developed by the Company; and the lighting installation they are putting in embraces "artistic" fittings, shades and lamps, switches and fuses. The services are connected, and nothing is left for the new tenant to do, but to switch on the light—just the same as he is able to turn a tap to obtain water. The fittings in the halls and living rooms are represented as high-class fancy ones, and in the other rooms as plain. As to their high-class character, views may differ; and we do not suppose they are of the semi-indirect or other eye-protecting sorts. However, the new movement shows the difficulty met with in inducing tenants to take to electric lighting, without there is almost compulsion—at any rate, without there is every inducement offered.

Cleanliness and Efficiency.

According to electrical theory, an electric lamp when once installed maintains its primal efficiency until it enters upon its eternal rest. That is the theory; the actuality is quite another thing. Among other misleading electrical teachings is that during their lifetime metallic filament lamps need no attention. In other words, by some occult power, bulbs, reflectors, and so forth do not get dusty and dirty. The teaching is not only misleading but mischievous; for it encourages a neglect which reduces the illumination of some electrically lighted premises and homes to a disgraceful condition. We were in a small suburban house the other day where electric light had been established. The cheap fittings were made up by flex with copper-finished ornamental pieces from which the lamps were suspended; and these metallic fittings had become pitted and rusty looking. The bulbs were dusty outside (as the lady of the house was afraid the filaments would collapse if a duster was shown them), and were distinctly discoloured inside. There was little need here for any special fittings for eye protection. In the small dining room with two 32-candle power lamps fixed over the table, there seemed to be a positive haze about the room; and it was quite impossible to read a newspaper a little distance from the table. At a railway station the other day, there was noticed an electric lamp suspended over the gate leading to one of the platforms. At night time through its ineffective aid, it must have been impossible for the spectacled ticket collector to properly see what was on the passengers' tickets. The lamp presented a very clouded appearance; and the coating appeared to be both inside and outside the bulb. It is all rubbish talking about metallic filament lamps consistently maintaining their original lighting efficiency; and the more economy that is displayed over the attention they get, the greater the loss of efficiency. These are the days of illuminating engineers, of pious professions of truth-telling by electrical experts, and of literature on the use and misuse of light!

Actual Results.

In a paper before the American Institute of Electrical Engineers, Mr. C. E. Clewell has been dealing with the question of the depreciation of the illumination given by electric lamps in factories and offices through neglect in the matter of cleaning; and his tabulated results are rather remarkable. In the tests four conditions were chosen: (1) New lamps and reflectors; (2) clean lamps (which had been in service for several months), and clean reflectors; (3) clean lamps (several months old) and soiled reflectors; and (4) soiled lamps and soiled reflectors. There are represented down-grade conditions. In the five factories selected for the testings, metallic filament lamps and glass reflectors were used. The figures show the actual efficiency compared with the theoretical efficiency that might be supposed to exist from calculations based upon candle-power distribution curves. The tests were made on the vertically downward, or (so-called) horizontal intensities of the illumination produced by a fairly large number of lamps in each location.

Results: Efficiency Per Cent.

Conditions of Test.	Low Office.	Fairly High Factory Office.	Low Factory Space.	Medium High Factory Space.	Fairly High Factory Space.
Time between washings . .	14 weeks	17 weeks	9 weeks	11 weeks	13 weeks
New lamps	34·1	31·2	31·9	36·1	39·1
Clean reflectors					
Clean lamps	34·1	29·3	31·2	35·3	33·6
Clean reflectors					
Clean lamps	20·7	24·9	22·5	27·0	23·6
Soiled reflectors					
Soiled lamps	19·7	24·2	22·4	25·0	20·1
Soiled reflectors					

We need only look at these figures from the relative point of view to see the notable degradation of efficiency according to the conditions in the matter of cleanliness, of lamps and reflectors for different intervals of time. Among the remarks upon his tests, Mr. Clewell says that in one large installation of 10,000 tungsten lamps, the loss of light due to dust is equivalent to £1500 per annum. In such a case, the consideration of the cleaning interval is very important. A further reference is to a large shop where an extensive installation of high efficiency lamps has been in use for nearly three years. In this case, there has been an increase of nearly 30 per cent. in actual candle power for a 5 per cent. increase in total operating and maintenance costs. The increase in candle power, however, in no way indicates the value of the great improvement in distribution and direction of light. Mr. Clewell's investigations will be useful when electricians sneeringly talk of the moderate amount of attention that is required for the maintenance of the illuminating power of the

modern incandescent gas-burner, which gives a light of a quality far less injurious to eyesight than the high intrinsic brilliancy filament of the metallic filament lamp.

Publicity. In discussing the report of the Council, at the recent meeting of the Incorporated Municipal Electrical Association, the question of expenditure on publicity, advertising, &c., was introduced; and one member urged that the electrical industry should follow the gas industry in having a proper organization for such work. Our old friend Mr. Alexander Cramb, who is (or was) a member of the Electricity Publicity Committee, says there is no way at present of meeting expenditure in this direction. But he has got his eyes on the British Commercial Gas Association; and he understands that this body has been trying to get the Local Government Board to cease surcharging such expenditure in the case of municipal gas undertakings. If the Commercial Gas Association are successful in this, he holds that municipal electricity undertakings would be entitled to spend money similarly without hindrance. The legal view was voiced by Alderman Pearson, of Bristol. His opinion is that a municipal authority whose accounts are audited cannot indulge in such expenditure without incurring the risk of surcharge. On the other hand, Mr. Shaw, of Ilford, points out that his authority are subject to audit; and the Local Government Board, in their case, raise no objection to expenditure of the kind, providing something is shown for it. The electrical industry has always been great at letting the gas industry do pioneer work, and then commencing operations on the foundations the latter has well and truly laid.

Provisional Orders. The Board of Trade have issued their report on the Electric Supply Provisional Orders dealt with by them during the year. The number applied for was 47 (23 by local authorities, and 24 by companies or persons). The Board appear to have gone into the proposals with good discrimination, with the result that 31 of them were granted, 7 were granted for reduced areas, and 9 were refused. The nine non-successes were in respect of Banbridge, Cwmamman, Dromore, Feltham, Rickmansworth, Romford, Lytham, Truro, Wood Green. The Lytham Order was an extension proposal by St. Anne's District Council; but the Lytham Council had themselves an Order before the Board, and gained the Board's preference. The unsuccessful Truro Order was the one promoted by the Gas Company. The Local Authority were granted an Order; and the Gas Company declined to be content with an Order for the area beyond the city. The Wood Green Order was a promotion by the North Metropolitan Electrical Power Company; but the Tottenham and Edmonton Gas Company were favoured locally. The Board since their last report have approved of nine transfers of Orders to companies. Among the consents to the construction of generating stations on certain specified land is one under the Aldershot Gas, Water, and District Lighting Act, 1909. Since 1883 and up to 1912, 1450 Orders have been applied for; 1161 have been made by the Board of Trade; of these 1143 have been confirmed by Parliament; and of the 1143 Orders, 354 have been revoked, repealed, or else have expired.

A Correction. Referring to the paragraph in last week's "Memoranda" on costs and charges at Hastings, there is a correction to be made. In the local "Observer," it was stated that, to a question as to the inclusive cost of electricity per unit sold in the borough, the reply was given that it was 0·98d. per unit. Upon this answer we commented. But it now transpires that the 0·98d. was a misprint, and that it should have been 4·98d. All we need say is, so much the worse for the argument in favour of certain of the low prices charged for electricity in Hastings. Someone has to bear the difference between the low figures charged and the average cost. There is no getting away from that plain fact, however much we wrestle with the factors that have been dragged forth in the effort to justify a magnificent variation of prices, and to endeavour to satisfy the smaller consumers that they ought to feel delighted at having to pay only a few hundred per cent. more than another man for precisely the same commodity—the very same in respect of energy capacity.

Sir Corbet Woodall's Institution Address.

The following appreciative remarks on Sir Corbet Woodall's Inaugural Address to the Institution of Gas Engineers appeared in the "American Gaslight Journal" for the 7th inst.: "The address of Sir Corbet Woodall was just such as would be expected from the acknowledged head of the English gas profession, and a man of his liberal views upon industrial problems. He gave an outline of the fifty years' progress of the industry, with an added personal touch of reminiscence that largely increased its interest. He dwelt particularly on the real goal of the operator, as laid down a hundred years ago by Samuel Clegg, who demonstrated what some of us have to learn over and over again, through costly experiment, 'that a high yield of gas is the most profitable aim of the gas manager.' He sees in the future our industry, working along this same line, a mighty force for the conservation of the natural resources stored up in world-wide coal deposits."

SOCIETY OF CHEMICAL INDUSTRY.

Annual Meeting in Liverpool.

THE Annual Meeting of the Society of Chemical Industry was opened in the Arts Theatre of the Liverpool University last Wednesday, under the presidency of Professor Marston T. Bogert, LL.D. The members were welcomed to Liverpool by the Lord Mayor (Sir J. S. Harmood Banner). The report of the Council showed that the number of members on the register was now 4244, compared with 4285 at the last annual meeting. During the year, 200 new members had been elected, against 237 last year; and the losses had been 257, compared with 253. The losses by death were 31, against 49.

In his Presidential Address, Professor Bogert dealt with the need of closer co-operation between the chemical industries and the Universities, and said that it was unnecessary to dwell upon the importance of chemistry to the prosperity of a nation. It was sufficient to point out that the amount of a country's appreciation of the value of chemistry was generally a measure not only of the industrial progress of that country, but also of its real civilization. Two of the most important factors in the advancement of chemistry were the Universities and the chemical industries; and it was consequently a matter of concern to all whether or not they were working at present to the best advantage.

On the motion of Dr. E. K. Muspratt, seconded by Dr. Rudolph Messel, a vote of thanks was accorded to the President for his address.

In the afternoon, a garden party was given by Dr. E. K. Muspratt at his residence, Seaforth Hall; and in the evening, the members were received at the Town Hall by the Lord Mayor. The annual dinner of the Society was held in the Adelphi Hotel on Thursday.

Eskmeals Coal-Dust Explosions Experimental Station.

On Saturday last about fifty members of the Society paid a visit to the large experimental gallery and station which have been established for investigations on the causes and the prevention of coal-dust explosions in mines. The party left Liverpool on Saturday morning in two special saloons, and spent about three hours in the afternoon at Eskmeals, which is on the coast of Cumberland, between Barrow and Whitehaven. The visitors were received at Eskmeals by Professor Harold B. Dixon, F.R.S., and Captain A. P. H. Desborough, R.A., on behalf of Sir Henry Cunynghame, K.C.B., the Chairman of the Home Office Executive Committee on Explosions in Mines.

The large experimental gallery which is the chief feature of the Eskmeals experimental station was installed at Altofts, in Yorkshire, in 1908, by the Mining Association of Great Britain. It was constructed of disused boiler-shells, 7 ft. 6 in. in diameter, and had a length of 600 feet. Investigations were carried on with it at Altofts for three years, at the cost of the Association; but it was then found desirable to move it to a place more remote from houses, and it was transferred to Eskmeals and extended to a length of 800 feet. From the time of transfer the work has been carried on at the public cost under the direction of an Executive Committee of the Home Office. Many interesting researches on coal have been made in the Eskmeals laboratories by Mr. R. W. Wheeler, the Resident Chemist, and his Assistants.

An explosion of coal dust in the large gallery was made on Saturday in the presence of the visitors. The floor was spread with coal dust, in the proportion of 1 lb. of dust per linear foot, for a distance of 750 feet; and inflammation was effected by firing 24 oz. of blasting powder from a cannon placed 50 feet from the closed end of the gallery. An immense cloud of black smoke came from the open end of the gallery; but on this occasion there was little flame—probably because the other or closed end blew out, owing to its having been only lightly sealed. The end plate and length of boiler had been blown away from the rest of the gallery in an experiment on the previous day; and it had been impossible to effect a permanent repair in the interim. While from a spectacular standpoint the explosion on Saturday was on this account not so striking as would commonly be the case, it afforded ample evidence of the disastrous character of coal-dust explosions.

The party were afterwards conducted through the safety-lamp testing station, where experiments are made on lamps in atmospheres of air and methane, and air and pentane vapour. Pentane is used merely as a convenient substitute for methane, which is rather difficult to prepare in quantity in a state of purity. In the laboratories demonstrations were given of the inflammability of different dusts, and of the effects of agitation on the inflammability of mixtures of methane and air. The various methods employed in researches on the nature of coal and in gas analysis were explained.

The party found the visit to Eskmeals most interesting and instructive.

In the list given in the "JOURNAL" for July 8 of students who passed in Grade I., First Class, in the recent City and Guilds of London Examination in "Gas Engineering," the name of "H. Goodwin" was mentioned. This should have been H. Goodier, who is engaged with the Runcorn Gas Company

THE REFRACTORY MATERIALS COMMITTEE'S SPECIFICATIONS AND THE WALTHAM ABBEY EXPERIENCES.

One cannot help feeling sympathy with the views on the refractory materials question of Mr. W. B. Randall, the Engineer and Manager of the Waltham Abbey and Cheshunt Gas Company. He has voiced these views at the last two meetings of the Institution of Gas Engineers; but the voice has been as that of one crying in the wilderness. The allusion in last week's issue to the subject of silica material brought an invitation from Mr. Randall to "come and see" what has been, and what is now, happening in his retort-house working to the specification of the Refractory Materials Committee. We have been and seen, and have come away convinced that there is subject-matter at Waltham Abbey for something more than a brusque dismissal of an awkward problem, or a mere cursory investigation.

A Clear Issue.

Here we find Mr. Randall is doing certain things, and obtaining certain results, which include the melting-down of his retorts. He specifies a refractoriness for retorts and retort material in accordance with the temperature prescriptions of the Refractory Materials Committee's specification; and the result is, that working (we will quote some exact figures presently) at temperatures some hundreds of degrees below the specified ones, disaster ensues. It is a fair question to ask, What is the good of specifying a certain figure for refractoriness if the figure has or can have no existence in fact? In their last report, the Refractory Materials Committee stated that they "are of opinion that a margin of about 1000° Fahr. above the average working temperature of retorts should give a sufficient factor of safety." But can the whole of the difference between the average working temperature and the specified temperature be regarded in any way as a factor of safety when the actual melting-point, under daily working conditions, is below the specified figure? We think not. Under such circumstances, some of the margin of safety is of no avail, is purely a paper figure or something fictitious, and has no intrinsic value whatever. There is no sense in prescribing 1000° Fahr. above the average working temperatures if it is an impossible figure for the makers of retort materials to work to; and it is idle to specify any refractoriness that is not within the realm of feasibility.

The Committee specify, in the matter of refractoriness, two grades of material: (1) Material which shall show *no sign of fusion* when heated to a temperature of not less 1670° C., and in the second grade when heated to a temperature of not less than 1580° C. But what happens when Mr. Randall runs his combustion chambers at say 1430° C., or 1450° C., and his retorts at (say) 1050° C. to 1150° C. Whichever figure one takes, there is a considerable margin between the Refractory Materials Committee's figures and the temperatures at which heating and carbonization proceed at Waltham Abbey; and this difference, with a variety of makes of material professing to be in accord with the specification, has not the slightest value as a margin of safety. There is no question as to the veracity of the temperatures at which Mr. Randall is working. They are signed temperature tests made by the Cambridge Scientific Instrument Company, and made with the Féry spiral pyrometer, as well as with the Féry radiation pyrometer. The temperature readings are produced freely for inspection. Here is one list showing an average of about 1450° C. in the combustion chamber with 1530° C. in an isolated case. Representative temperatures inside the retorts are 1150° C., 1075° C., and 1200° C. In another run of tests taken on another day, we have round about 1430° C. and 1450° C. in the combustion chambers; and representative retort figures are 1090° C., 1100° C., 1055° C., and 1200° C. The working temperatures at which there has been trouble with the fusion of the retorts have never reached the specification temperatures for refractoriness, at which there was to be "no sign of fusion." Here then is a very clear issue. Of what value is the so-called margin of safety, if disaster is reached before the safety margin has been exhausted?

An Oxidizing or Reducing Atmosphere.

It is admitted that the temperatures worked at Waltham Abbey are somewhat higher than customary. But that does not dispose of the question as to the value of prescribed temperatures a distance away from which serious trouble is encountered; and it ought to be possible to work with a much lower margin of safety than 1000° Fahr. As is well known, Mr. Randall is of opinion that the specification is at fault in prescribing an oxidizing and not a reducing atmosphere in the test-furnace. In their last report, the Refractory Materials Committee defended their choice, pointing to the difficulties of making reliable tests, owing to the inconstancy of the composition of a reducing atmosphere, and bringing custom and simplicity to their support. Moreover, it was added: "It is felt that the factor of safety which has been allowed is ample for any possible prejudice to the purchaser on this account." The Waltham Abbey experience, as we have shown, disputes the validity of a substantial part of the so-called factor of safety. Now Mr. Randall holds that the reasons advanced against his contention are insufficient—that the question of reliability of refractory material, and the commercial importance that attaches to the attaining of higher temperatures without such difficulties as he experiences, are of superior importance, and that the science of the laboratories and the wisdom of their conductors ought to be equal to conforming the test with the conditions of everyday working. An oxidizing atmosphere was all right in the days of direct firing; in these days of regenerative firing, such a test is a pure solecism. The laboratory practice of 25 years ago wants reforming, and made to coincide with current working circumstances of the retort-house. The last report of the Committee was not very strong in the wording of the defence of its choice; and this is an indication that the Committee see there is some amount of justice in the criticism of the test use of an oxidizing atmosphere. At the same time, no one from among the experts—not even the National Physical Laboratory—comes forward to show the way of escape from the bondage of the oxidizing atmosphere. "Custom" and "simplicity" govern. Upon this point, therefore, the experience at Waltham suggests that there is good ground for a serious, systematic, and independent investigation. The Committee, themselves show that their conclusions emanate simply from the advice they have received, when they say: "The information at present available to the Committee shows," &c.

A Commercial Question.

Although the high temperatures at which the carbonizing work is being conducted at Waltham are, to the extent already shown, below the specification, trouble to a serious degree develops in from eight to twelve months. The retorts used are Ω stop-ended ones, 10 ft. by 22 in. by 16 in. There is no question as to the cost per foot run to secure a refractoriness that can be worked at temperatures that will give large makes. "It will pay us," says Mr. Randall, "if we can get material that will stand the temperatures mentioned in the Committee's specification, to pay a good price for it." That is his position. He looks at the question entirely from the commercial point of view; and he consults the ultimate condition of the balance-sheet to find whether or not the credits from increased make and lessened expenditure for coal per unit of output more than counterbalance the debits attached to the working at higher heats. He is satisfied that they do, and will do so still more, if a more reasonable life can be obtained within even the temperature limits of the present specification of the Committee. He is not so unreasonable as to suppose that he is going to work at these high-pitched temperatures and get the same working life out of the retort material as by working at lower temperatures. The gravamen of his complaint is that he cannot obtain what the specification for refractoriness leads him to expect he should be able to secure, and which the industry must make a strong effort to secure in its own commercial interests. With such a position confronting as high coal and oil prices, descending markets for residual products, and coke not being taken up so freely as could be desired, and with the broadening of the commercial operations of competitors and the sharpening of their tactics, the gas production of the retort-house has to come to the further aid of the industry. This is the position, in brief, which urges that the question of retort material under the specification should not remain where it is. Material from different sources under the specification has been put into the Waltham scales and found wanting; and what is the cause? Either the specification is not worked up to, because the manufacturers cannot work up to it, or else the temperatures at which Mr. Randall is operating are higher than represented. But these are attested by the Cambridge Scientific Instrument Company. This being so, there can only be one conclusion in the absence of further evidence, and that points to the material itself.

The settings at Waltham are of the Klönne type, with Hudson producers. As already mentioned, the retorts are stop-ended ones, 10 ft. by 22 in. by 16 in. The secondary-air tubes are 5 in. by 5 in.; and the gas tubes, 5 in. by 3 in. There are eight retorts in a setting. The make of gas last year from Barrow and Aldwarke Main coals was 14,593 cubic feet per ton carbonized; the unaccounted-for gas was between 5 and 6 per cent.; and the quantity actually paid for averaged 13,580 cubic feet per ton—the difference between that (*plus* the unaccounted-for gas) and the make being represented by works and office consumption. The gas is of 14½-candle power. The system of anti-dips is the practice.

What was Seen.

On the works was seen a heap of fire-clay material from dismantled settings, and which material was in use for about twelve months at only about the temperatures mentioned earlier in the article. A block of material was picked up with gas and air flues (of smaller dimensions than mentioned above) that had at one time led to a combustion chamber. The nozzle-end was completely blocked up by material, liquefied by fusion, which had run down from the retorts, and formed a honeycombed mass and an effectual seal. Other ghastly evidences were seen of failure to meet requirements within the terms of the specified refractoriness. The gas-flues (as stated) are now made 5 in. by 5 in. and the air-flues 5 in. by 3 in., so as to give a larger area; and at each side of the combustion chamber, channels have been formed for the capture of the flux, so as to admit of it being periodically removed. Inside the retort-house, the heats were seen in combustion chambers and in retorts. There could be no question as to

the high intensity; but there are the pyrometrical readings which show them to be well within the specification. From one of the channels at the side of the combustion chamber of No. 3 setting, there was removed by a scoop some incandescent liquid of about the consistency of tar. As it cooled, it gradually passed from the liquid to a plastic state, and then set into a black, solid, vitreous substance. This No. 3 setting has only been in use for about nine months, and its next door neighbour—No. 4—about eight months; but as the retort-house foreman puts it, "they are all on the run," though the temperatures are well within the specification. The same thing is found with segmental as with moulded retorts. In one retort particularly, one was able to see the bad effect of the temperatures upon the material supplied to the specification.

A Challenge, and the First Result.

The experiences of Mr. Randall led him to ask makers whether they would be prepared to supply a certain number of retorts, on the condition that, if they would not stand the Waltham working conditions for twelve months, the retorts were not to be paid for. Only one English firm and one German firm responded to the challenge. The retorts are only 10 feet long. The German ones have travelled some 600 miles, and have been delivered and deposited on the works without the slightest damage to them; whereas in the case of two of the half-dozen English-made retorts, in depositing them on the works, they were completely broken through transversely. The cause of this has not been determined, but it does not suggest a great tensile strength, whatever may be the refractoriness. The German retorts are, it is also noticed, altogether more shapely, and present a splendid external finish, without fissures or blemishes in the way of indentations and superficial roughness. As retorts must be handled to get them from makers' to users' works, and then into the setting where they are to pursue their destined functions, a high refractoriness without a good tensile strength will not prove of great avail.

An Opportunity for Useful Investigation.

These experiences at Waltham Abbey suggest that—the plant being of a size in which experimental work can be conveniently carried out (though the Company are not in a position to keep a highly trained staff in their pay for such purposes)—useful independent research could be made there to arrive at some determination as to differences that exist between specifications and makers' tests on the one hand, and working experiences and temperature testings *in situ* on the other. This is the only way in which the matter can be cleared up; and, if it was taken in hand, under the auspices of the Refractory Materials Committee, something useful might ensue for the whole gas industry. It is not a matter that should be dismissed in any off-hand way. An opportunity is here presented for—let us repeat—*independent* research, and the opportunity should not be missed.

THE QUALITY OF LONDON GAS.

Second Quarter of 1913.

The following is a summary, in customary form, of the results of the official testings of the gas supplied by the three Metropolitan Gas Companies during the second quarter of the present year. The similar figures for the first quarter of this year were given in the "Journal" for April 22 last (p. 235); and for the second, or corresponding, quarter of last year in the "Journal" for Aug. 6, p. 381. The period referred to in the ensuing summary as the second quarter of the year is the thirteen weeks ended June 28.

Illuminating Power.

The average results of the testings of illuminating power, with both the No. 2 "Metropolitan" argand burner and the prescribed flat-flame burner, are given in Table I., in which the figures for the corresponding quarter of 1911 and of 1912 are also given for comparison. It will be seen that, as compared with the corresponding quarter of last year, there is no appreciable change in the average illuminating power of the gas supplied. As usual in recent years, the average illuminating power of the coal gas supplied by the South Metropolitan Gas Company is about 1 candle higher than the average illuminating power of the mixed gas supplied by the other two Companies. The minimum returns for the argand testings during the quarter were: For the Gaslight and Coke Company, 12·36 candles; for the South Metropolitan Gas Company, 14·16 candles; for the Commercial Gas Company, 13·70 candles. In each of the thirteen weeks of the quarter, the Gaslight and Coke Company had at least one return below 14 candles, and in three of the weeks at least one return was between 13 and 13·5 candles, and in two other weeks at least one return was below 13 candles. A single day's return below 13 candles renders the Company liable to incur a forfeiture; whereas with returns between 13 and 13·5 candles, the average of the results of three consecutive days' testings must be 13·5 candles or lower in order to penalize the Company. It is impossible to say from the data available in the published returns in what cases a forfeiture would actually have been incurred, if the deficiency should not have been proved to the satisfaction of the Chief Gas Examiner to be due to an unavoidable cause or accident. The minimum results of the testings with the flat-flame burner were: For the Gaslight and Coke Company, 6·48 candles; for the South Metropolitan Gas Company, 8·22; and for the Commercial Gas Company, 7·39.

Table I.—*Averages of All the Testings of Illuminating Power for the Second Quarter of the Year* [*Candles*].

Company.	No 2 "Metropolitan" Argand.			Flat-Flame.		
	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke .	15·00	14·46	14·42	8·75	8·25	8·21
South Metropolitan.	15·81	15·53	15·56	10·08	9·27	9·64
Commercial . . .	14·61	15·03	14·65	8·47	8·65	8·30

Calorific Power.

The results of the testings of calorific power during the quarter are summarized in Table II. There is a slight increase in the average calorific power of the gas supplied by the Gaslight and Coke Company and the South Metropolitan Gas Company, as compared with the average for the corresponding quarter of last year. The calorific power of the coal gas supplied by the South Metropolitan Gas Company averages about 7 calories per cubic foot more than that of the mixed gas of the other two Companies. The Gaslight and Coke Company alone are liable to incur forfeitures for deficiencies of calorific power, and the lowest result reported for their gas during the quarter—viz., 113·3 calories net—is above the standard of 112·5 calories specified in the Company's Act. The minimum value of 112·4 calories net for the Commercial Gas Company recurred in three different weeks of the quarter.

Table II.—*Summary of Testings of Calorific Power (Gross and Net) for the Second Quarter of the Year* [*Calories per Cubic Foot*].

Company.	Average.			Maximum.			Minimum.		
	1911.	1912.	1913.	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke—									
Gross	138·4	134·4	135·9	148·6	145·4	145·4	130·0	123·7	126·6
Net	123·3	119·9	121·0	132·4	130·4	130·0	114·3	112·6	113·3
South Metropolitan—									
Gross	145·3	142·9	143·7	154·8	154·3	156·4	134·7	132·7	134·7
Net	129·5	127·3	128·0	139·4	137·5	139·8	120·2	118·2	119·2
Commercial—									
Gross	137·2	136·0	135·0	151·7	147·9	145·8	124·0	123·8	124·7
Net	122·3	122·0	120·7	132·5	134·6	131·0	110·0	112·0	112·4

Sulphur.

The average and maximum figures for the returns of testings for sulphur are given in Table III. It will be seen that the average for the South Metropolitan Gas Company continues to fall from year to year—doubtless owing to the extension of the use by the Company of Evans's catalytic process of purification. For the other two Companies, the average is somewhat higher than in the corresponding quarters of the previous two years. The maximum figures for sulphur returns are necessarily somewhat erratic; and while rather higher this quarter than in the second quarter of last year, they do not call for any special comment.

Table III.—*Summary of Testings of the Sulphur in London Gas for the Second Quarter of the Year* [*Grains per 100 Cubic Feet*].

Company.	Average.			Maximum.		
	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke .	33·9	34·3	38·0	56·1	52·3	62·2
South Metropolitan	26·3	24·1	22·8	44·1	44·8	50·3
Commercial . . .	29·8	25·0	30·4	51 6	40·6	45·9

Society of Arts Chairman.—The Council of the Royal Society of Arts have elected Colonel Sir Thomas Hungerford Holdich, R.E., C.B., as Chairman for the ensuing year.

Proceedings of the Optical Convention.—We have received from the University of London Press the volume of proceedings of the Optical Convention held at South Kensington in June last year, and noticed in the "Journal" at the time so far as our special class of readers were concerned. It is the second of the series—the first having appeared as far back as 1905. There is, however, a connection between the two; and the possessor of the volume under notice is thus put in a position to make himself acquainted with the exact state of knowledge at the present time. For the most part, the papers are summaries of research upon an extended scale, or suggestions of the lines which scientific work will have to follow in the immediate future. In these respects the volume, the contents of which occupy about 350 quarto pages, is of very special value. The price of the book (published by Messrs. Hodder and Stoughton, Warwick Square, E.C.) is 10s. net.

ALKALI WORKS CHIEF INSPECTOR'S REPORT.

THERE was issued last week the forty-ninth annual report of the Chief Inspector under the Alkali Works Regulation Act, 1906 (Mr. W. S. Curphey). The period covered is the year 1912; and the report is, as usual, followed by the reports of the various District Inspectors, and by that presented to the Secretary for Scotland.

Mr. Curphey begins his report by stating that the number of works in England, Ireland, and Wales registered under the Act was 1305, in 73 of which salt was decomposed with evolution of muriatic acid, and requiring registration under the definition of "alkali works." In the remainder, operations were carried on which called for registration under section 8, or as one or more of the works enumerated in the first schedule of the Act. There was thus a decrease of one in the number registered as alkali works, and an increase of ten in the number otherwise registered, as compared with 1911; the net increase being nine. There were also 166 works in Scotland registered under the Act; making in all an aggregate of 1471 for the United Kingdom. The number of visits to works last year was 5980, and of tests made 6094. The total number of visits and tests made during the year is smaller than during the previous year. This was due to the prolonged and widely spread coal strike during the spring of 1912. Not only were many works closed temporarily, but the railway train service was so disturbed that travelling was greatly interfered with. The general average amounts of acid gases escaping exits for waste gases in works under inspection showed slight variations from the preceding year. The acidity of gases of all chimneys, however, showed a distinct increase—being equivalent to 1·218 grains of sulphuric anhydride per cubic foot, as compared with 1·192 grains during 1911. This increase was chiefly due to those works in which ores containing metallic sulphides were calcined. In addition to these measurements of acidity in exit gases, which indicate discharges into the atmosphere at elevations more or less removed from the ground, the general conditions of the works received much attention, as in past years, with respect to the circumstances under which chemical operations were carried on inside the works, and as regards influence on the immediate neighbourhood of the works from possible escapes of gases at lower levels. There is further improvement to report in this direction, due partly to the adoption of hoods (whereby the fume incidental to the withdrawal of heated material from furnaces was draughted to the chimney), and partly to the further extended use of mechanical furnaces which avoid entirely the escape of fume associated to some extent with the discharge of the hand-furnaces previously in operation.

With regard to sulphate and muriate of ammonia works, Mr. Curphey reports that the number of processes under inspection last year was 639, or nine more than in 1911. It was at one time anticipated that this increase would have been greater; but the coal strike led to delay in erecting several new plants. It is, he says, likely, however, that this development has only been delayed, and that the future will permit of further extension in capacity for the production of bye-products from the carbonization of coal. Through the courtesy of manufacturers, he is enabled to continue to present figures showing the quantity of ammonia (expressed in terms of sulphate) recovered in the United Kingdom as a bye-product from the industries indicated in the following table:—

—	1912.	1911.	1910.
	Tons.	Tons.	Tons.
Gas-works	172,094	168,783	167,820
Iron-works	17,026	20,121	20,139
Shale-works	62,207	60,765	59,113
Coke-oven works	104,932	105,343	92,665
Producer-gas and carbonizing works (bone and coal)	32,049	29 964	27,850
Total	388,308	384,976	367,587

Mr. Curphey says it is worthy of note that the production of sulphate of ammonia was greater by 3332 tons last year, despite the widespread disturbance due to the coal strike. Two industries—iron-works and coke-oven works—yielded a reduced production; while gas-works, shale-works, and producer-gas with carbonizing works yielded an increased production sufficient to provide the net increase just mentioned. He explains that the decided increase in the production in gas-works is one result of the preparedness in so many of these works to meet the demands for gaseous fuel at a time when the price and scarcity of solid fuel turned consumers' attention in other directions.

The "direct" method of producing sulphate of ammonia—*i.e.*, by exposing the gases resulting from the carbonization of coal to the action of sulphuric acid instead of removing ammonia from these gases by a washing process producing gas liquor or ammoniacal liquor—was put into more extended use last year. It was chiefly in the coke-oven works, however, that this development occurred. The adoption of the method as adapted to gas-works practice did not expand to any great extent, though in the gas-works where the necessary plant was already in existence it continued in satisfactory operation.

The remarks made in the two previous reports as to the loss of ammonia while handling and storing ammoniacal liquor has, the Chief Inspector remarks, still reason for reiteration; but, he says, the loss from this source must be much less than that due to the many instances where ammoniacal liquor from the smaller or less conveniently situated gas-works is discharged unutilized into the sea or some adjacent watercourse—a valuable material becoming thus a possible source of offence. Dr. Fryer, in whose district (the south and south-west) there are many such works, refers at length to this matter in his report, which will be noticed in a subsequent issue. The loss throughout the country as a whole must be very considerable.

Attention continued to be given to the formation of a commercial salt of ammonia, such as the sulphate, from gases containing ammonia and sulphuretted hydrogen without the use of sulphuric acid; but Mr. Curphey says that, so far as practical production in this country is concerned, it cannot be said that permanent success has yet rewarded the perseverance, energy, and ingenuity of those actively associated with the introduction of the newer methods. Towards the end of 1911, advanced progress had been made with plant for operating one of these processes on a manufacturing scale of some magnitude; and a commencement was made in the early part of last year. The plant had been modified in certain details, and so differed somewhat from that previously operated elsewhere, and the results were not so satisfactory as anticipated. After being in operation for a time, the plant was stopped, and the further working of this particular plant is still under consideration. Meanwhile, no further actual progress has to be reported.

There is, however, more than one process which it is claimed has satisfactorily solved the problem of obviating the use of sulphuric acid; and the Chief Inspector thinks it is permissible to hope that an effective method of directly utilizing the sulphuretted hydrogen associated with ammonia in the gaseous products of the destructive distillation of coal may call for notice in an early future report. In the meantime, much of the sulphuretted hydrogen in question is now utilized in the manufacture of sulphate of ammonia through the intervention of the oxide of iron purifier or with direct combustion and the chamber process of sulphuric acid manufacture.

No change has to be noted as to the methods in use for dealing with the noxious gases evolved during the distillation of gas liquor. As in former years, part was utilized in the manufacture of sulphuric acid, part in the recovery of sulphur by the Claus process, part was burnt, and the resulting sulphurous acid was neutralized by limestone, part was decomposed with formation of metallic sulphides, and much was absorbed in the oxide of iron purifiers.

The oxide of iron purifier has proved to be the most widely applicable of these methods, and was in use in all parts of the country last year. The older forms of box or brick-walled purifiers, which were the immediate product of adopting the practice previously existing in gas purification for a different set of circumstances, are gradually being replaced by the more modern heap purifier, of which two varieties are now in use. One consists of a restricted area for passing the foul gases, surmounted by a conical heap of oxide of iron, the shape of which is determined by the angle of repose of the particular oxide in use. The other consists of a more extensive area for the passage of the foul gases covered with a layer of oxide of iron of suitable depth—the whole forming a low flat-topped heap with slides sloping at the angle of repose. Mr. Curphey considers that, for many reasons, the latter form is much to be preferred, though either is better than the older form with enclosing walls. Excepting where operations are intermittent, and idle periods recur alternately with short periods of working, it is desirable to have two or more purifiers, so that the foul gases may be diverted readily from one to another as desired by means of a suitable water-lute change-valve. Frequent change is of advantage in avoiding the formation of an unduly large quantity of sulphided oxide, with consequent tendency to undue rise of temperature during revivification. When comparatively small quantities of fouled oxide have to be dealt with, revivification is facilitated, and danger of firing is reduced.

The behaviour of oxide of iron during fouling and revivification, which was considered at some length in the preceding report, was the subject of further inquiry during the past year, as opportunity offered available time not occupied with other duties. The Chief Inspector gives an account of the more salient points dealt with in his laboratory in connection with this question, and takes the opportunity of acknowledging the zeal and interest Mr. Linder, his assistant, has shown in ably furthering the work. This portion of the report is dealt with elsewhere—pp. 238-45.

The number of tar-works registered under the Act continues to increase with each succeeding year. The number reached 179 in 1912—an increase of 16 as compared with 1911. Mr. Curphey explains that this is in part associated with a tendency for the erection of the necessary plant in works for the treatment of the crude tar at the place of production, instead of sending it to chemical works, where it may be dealt with collectively in larger quantities, and in part due to the erection of tar-stills in new coke-oven works provided with bye-products recovery plant. The development of the use of tar for road surfaces, and the recognition that crude tar is not so desirable as the prepared material, have led to a local demand in many districts, which has encouraged the erection of tar-distillation plants to provide a convenient local supply of suitable material.

The noxious gases evolved in this class of works were, as a rule, efficiently and satisfactorily dealt with throughout the year. In

one case, however, warning had to be given by the Chief Inspector as to the maintenance of proper oversight of the means provided for dealing with these gases. No alteration in the methods in use for preventing the escape of noxious gases from this class of works occurred in 1912. As in previous years, the gases were dealt with by combustion under proper safeguards, absorption in oxide of iron or lime purifiers, or in those charged with a mixture of these two materials.

In conclusion, the Chief Inspector expresses his appreciation of the aid he received from his colleagues in carrying out the administrative duties under the Act, and from Mr. Linder likewise in this direction as well as with regard to the experimental work already referred to.

"SIMPLE ELECTRIC COOKERY."

THE first electric cookery book has been published. It is entitled "Simple Electric Cookery;" and its author is Miss May Little, of the City School of Cookery, of Norwich. On learning of its issue, and thinking it was a book that might be reviewed in the "JOURNAL," and wishing to be courteous, we wrote to the publishers, Messrs. Jarrold and Sons, to give them an opportunity of sending a copy for the purpose. We suppose the publishers consigned our letter to the waste-paper basket or to the pigeon-hole for such undesirable communications, as they have not had even the courtesy to acknowledge our communication—assuming that the non-delivery of an acknowledgment by a postman may be taken as presumptive evidence of their neglect. However, the revenue of the publishers (our object in first writing was not to save this) is to-day greater by 1s. 6d., less the discount allowed to the poor bookseller who strives in these competitive days to earn enough to maintain a respectable existence among men.

As we state, the title of the new book is "Simple Electric Cookery." The title is an admirable one, as applied to the book; as applied to electric cooking, the book itself rather disputes the fitness of the adjective. The part of the book that can be truly looked upon as referring specially to electric cooking is written in simple style and language, though Miss Little has been rather prodigal with generalities, and has not given sufficient hard facts. Perhaps, however, she can excuse herself on this score, by the fact that of 128 pages of letterpress, excluding index and advertisements, only 17 are devoted to "Hints and Notes on Electric Cooking," and 111 pages to cooking recipes. "Little," "simple," "hints," and "notes"!—there is a certain friendly congruity between these expressions which we are pleased to acknowledge.

SIMPLICITY AND CARE.

The seventeen pages of hints and notes are searched for any evidence of the appositeness of the term "simple" to electric cookery; and the general impression left on one's mind is that it is not so simple after all, and that there is much scope for waste and trouble, the avoidance of which claims the most affectionate and constant care on the part of the cook. A new order of cook, and a more highly paid one, will be wanted for this electric cooking business. Education and brains must be duly compensated. The cook must be one who is not in the habit of leaving switches on; one who must be able to deal with the battery of switches on the wall in front of her, quite as well as the telephone exchange girls have to know their business. She must be able to read thermometers—anyway, it is preferable, because the oven should be fitted with a thermometer which can be read outside. She must have strong will power, so as to overcome the feminine propensity for examining things at close quarters. The oven should be fitted with an electric lamp, which ought not to get its glass steamed and greasy (but which does), and the oven-door should have a window in it, so that, if the cook has eyesight that can, by the aid of the steamed lamp and the steamed window, penetrate the cloud of greasy steam in the oven, she will be able to ascertain how the joint is getting on without opening the oven-door. This keeping the oven-door shut is as positive an essential in electric cookery for economy's sake as is the keeping of the mouths of some people shut for preventing a disclosure of their under-measure of intelligence.

Miss Little is great on "care" being taken in the use of electric cooking apparatus; and she testifies that it is all not nearly so simple as the title of the book indicates. We find her saying that "if reasonable *care* is taken to regulate the current, the loss is very small." That is to say, if "reasonable care" is not taken the loss of current will be large." Again, "a joint *carefully* cooked in an electric-oven does not lose more than 10 to 15 per cent." Therefore, if it is not carefully cooked, it will lose more. Then, "*care* must ('must' is printed in small capitals to emphasize it) be taken to ensure that the utensils are not knocked about or dented, as they will not make proper contact with the hot-plate, and *great inefficiency results*." Experiments enable us to agree with Miss Little. Passing on, "*care* must be taken in making a selection [of an electric oven] to choose one in which the positions of the heating elements are well arranged, so as to give the best possible results; and it is advisable to choose an oven in which the elements [*sic*] can be easily replaced if one [*sic*] breaks down, and in which they are well protected from injury, especially when cleaning, as water coming into contact with the elements may lead to trouble." Cooks, too, should take *care* that the oven-door is a good fit, and is always fastened when cooking. We get the point again emphasized that, in roasting a joint, "if reasonable *care* is taken in controlling the heat, the best possible results can be obtained." In talking of the use of the residual heat of the oven for baking light sponge cakes and pastries, it is observed that, "*if care* has been taken not to allow the oven to cool too much, they will cook without any extra current, as *some* stoves retain their heat for over *half* an hour." But earlier in the book we read that not merely "some" but "many" ovens retain the heat for as long as *three quarters* of an hour after the current has been switched off. It may be suggested to Miss Little that this extraordinary refinement in care which she puts forward so obtrusively as a *sine quâ non* to electric cooking, and without which the latter must be a positive failure, is not to be obtained in an ordinary kitchen, however possible it may be in a school of cookery.

A QUESTION OF TEMPERATURES.

As an expert electric cook, Miss Little is interesting on the subject of temperatures and heat—interesting because some of the statements ruthlessly and altogether upset some cherished heat theories. To the lady, we humbly suggest that there should be some revision of the book in this connection. First, it is stated that, with the electric oven, "the heat is available immediately," and can be regulated at ease. The immediate availability of the heat is a little vague; and we demur to the statement that it can be regulated with ease. "It is regular and uniform, and *always* reaches the same temperature in the same time, so that the results are always certain." If this be so, then why the need for the "care" about which Miss Little is so solicitous? Many factors intervene in this matter of temperature regularity. Construction and the contents of the oven, and the condition of the heating elements step in. The overlapping of temperatures from one stage to another disturb conditions—for instance, when reducing from "full on" to (say) "half on." Miss Little herself, asserting it in one place, denies indirectly the regularity of the temperature of the oven. "The temperature," she says, "depends entirely upon the length of time the switches are 'on;' and most makes of cookers retain the heat for a long time after the current is off." Heat retention, of course, depends upon the character of the material used in, and the form of construction of, the oven. But really this heat control of the electric-oven is all a fiction. Under the circumstances related by Miss Little, if the heat cannot escape, and the cook desires to reduce the temperature, the mere switching off from (say) "full on" to "half on," will not effect the purpose; seeing that "the cookers retain the heat"—that is to say, in the illustration we are taking, the full-on heat—"for a long time after the current is off." Following on this statement as to heat retention, our author says that "this [? the heat retention] is called cooking in residual heat, and adds considerably to the economy of cooking by electricity."

There is further evidence that Miss Little thinks that, by some remarkable intervention of a fairy godmother, the heat generated by electrical energy will pass less rapidly through the materials composing an electric-oven than through the same materials if used to build a gas-oven. She says "if reasonable care is taken to regulate the current, the loss is very small." What regulation has got to do with heat losses under the heat-retaining characteristics of the electric-oven is not clear. Whatever the heat developed, it should not be lost—as the argument is presented in the book. It is, in fact, stated beyond dispute that "*all* the heat is utilized, instead of being lost in radiation and flue gases, as in the case of coal-fires and gas." Now as we understand the question of heat absorption and transmission as pictured by Miss Little, it appears that when an oven is heated up to cooking temperature, and when the materials of which the oven is constructed are heated through, they do not absorb any more heat, nor do they increase in temperature, and moreover heat radiation and convection laws come to an absolute dead-stop in the interests of the electric-cooker. This being so, when the temperature-reducing effect of introducing a cold joint into an electric-oven has been overcome, and the joint has reached throughout the temperature of the oven, then as "*all* the heat is utilized, instead of being lost in radiation and flue gases," as in the case of those much electrically-maligned gas-cookers, the switches ought to be turned off completely; for, the more heat thereafter poured into the oven, the higher must become the temperature. Miss Little must either own up to this being the case, or else she must recede from the position taken up in her book. There is another thing that her statement literally means. "*All* the heat is utilized, *instead* of being lost in radiation and flue gases, as in the case of gas and coal fires." That is to say, "all" the heat generated in the gas-oven is lost in radiation and flue gases. This being so, how is it cooking is done at all in a gas-oven, with "*all*" the heat trotting off by radiation and by way of the oven vent. If "all" heat is lost as represented, there can be no shrinkage of joints; they must remain practically raw. But in all seriousness, we ask Miss Little whether her words are true; and why gas generated heat should have a greater radiating power *outside* the oven than electrically generated heat. We do not like to say that a lady living in the highly respectable cathedral city of Norwich is not telling the truth; but the statements are a bit amazing and—forgive us!—amusing.

COSTS.

When we arrive at the costs of cooking, and the assumed economy, we again come to grief in our efforts to make the statements in the book square with facts. We have seen how a high order of intelligence is required for electric cooking, how apparatus must be equipped in an expensive manner to assist the

cook (and, we may add, to help to obviate disaster), we have seen too, the tender care that must be exercised in dealing with the oven, and in handling pots, pans, and kettles. Our authoress is painstaking in not committing herself to any facts regarding the cost of cooking and water-heating on the top-plate, to say nothing of the time occupied in obtaining service from it. Water requires a greater expenditure of heat to raise it degree by degree Fahr., than most other substances. Yet Miss Little states "that cooking by electricity is economical *in every way* is certain, and can be conclusively proved by anyone who tests it for themselves." (*Sic.*) One of the few definite statements that Miss Little makes is that, if current be obtainable at 1d. per unit, and even lower for cooking, it compares favourably with gas at 2s. 6d. per 1000 cubic feet of gas." She does not say what is meant by this—whether she includes in the comparison all work done inside a gas-oven and by its top burners. But we do get something of a more categorical nature later on. She remarks: "The cost of using an oven for roasting a joint *averages out* to about 1d. per hour, when the current is 1d. per unit, as full heat is only required for a small proportion of the whole time required [the tautology is not ours] to cook the joint." Very well. This is for a joint only. The statement may be taken in conjunction with the time rules in the book. First, we see it will take 20 minutes to get to full heat in the electric-oven. Then joints of beef must be allowed 20 minutes to the pound, and 20 minutes over; mutton 23 minutes per pound and 23 minutes over; lamb, veal, and pork 25 minutes to the pound, and we take it 25 minutes over. In some ovens, too, it is advisable to switch-on to full heat for a few minutes to make the joint brown and crisp.

Assume, then, a joint of lamb, weighing 10 lbs. Twenty minutes are required for heating up, ten times 25 minutes for roasting, equals 250 minutes, and 25 minutes over—total, 295 minutes, or five hours all but five minutes! Therefore, to have the 10-lb. joint finished in time for Sunday dinner at 1.30, operations would have to be started at 8.30; and unless the oven is properly ventilated, so as not to have a steam-supersaturated atmosphere in it, the oven cannot meanwhile be used for anything else for which a crisp exterior is required. The five hours, averaging out to 1d. per hour for current, will cost 5d. With gas the 5d. would buy, at 2s. 6d. per 1000 cubic feet, about 82,500 B.Th.U.; with electricity, 17,100 B.Th.U. Now we would ask Miss Little whether, in all sincerity, she believes that, with gas, it will take inside the oven 65,400 B.Th.U. more to do what 17,100 B.Th.U. with electricity will accomplish; for that is what her statement amounts to. If she does sincerely believe it, will she give us some sound fundamental reasons for her belief. We do not want to be unfair in this matter; we desire to get at the root of these electrical generalizations and fallacies. From some records of gas consumptions by us, we see that, in cooking a 4 lb. joint of beef and sundry other things in a gas-oven, 25 cubic feet of gas were consumed; and the time occupied was 1¼ hours. At 2s. 6d. per 1000 cubic feet, the cost would be ¾d. In another make of gas-oven, a leg of lamb, weighing 5 lbs., took 21 cubic feet of gas, costing 0·66d.; and in a third type of oven 5¾ lbs. of ribs of beef took 18 cubic feet of gas, costing slightly over ½d. The 5¾ lbs. of ribs of beef would, according to Miss Little's rules, have claimed 4¼ hours' use of the electric-oven, and a cost of 4¼d., at the average of 1d. per hour, and 1d. per unit of electricity.

The Shrinkage Question.

Our authoress puts her case in such an extremely simple fashion, that one almost feels a certain restraint in pursuing the criticism. But Miss Little will agree that, her book being in the interests of one side in a commercial fight, the other side has a right of reply, including criticism and challenge. We have already put certain points to our authoress; there are others. Some of these points, we have submitted to other writers and platform orators who have exercised themselves in the interests of electric cooking. The writers and orators have been mostly of the masculine sex; and they have shown their courage by, in respect of our inquiries, a death-like silence. It is to be hoped, therefore, that Miss Little will show that she has stronger courage, and will reply categorically in our columns to the criticisms already made, and the one that is to follow.

To make the credits to electric cooking show a balance on the right side, our authoress takes refuge in the shrinkage question. But let us see how she does it. "In cooking by gas or coal," she remarks, "the loss on roasting a joint is *estimated* at 25 to 30 per cent. A joint *carefully* cooked in an electric-oven does not lose more than 10 to 15 per cent." Why give "estimated" figures for joints cooked in gas-ovens? Miss Little is invited to tell us what is the loss of weight when a joint is *carefully* cooked in a gas-oven? The statement shows that Miss Little knows, as well as we do, that in an electric-oven a joint can be made to lose almost anything, just as in a gas-oven. Assuming careful use of the gas-oven, the use of the same temperatures and joint cooked to the same degree, why should there be any greater waste in the gas-oven than in the electric one? Miss Little would be very shocked if anyone accused her, and she would strongly resent it, of playing unfairly in any game. The question is therefore put to her whether she has, in her statements quoted above and below, dealt fairly between gas and electricity. She states that "a joint, weighing 10 lbs. when bought, will weigh roughly about 7 lbs. when it comes to the table if roasted by gas or in a coal range, showing a loss of 3 lbs.; whereas *it will lose possibly only* about 1¼ lbs. when cooked in an electric-oven." Now what has Miss Little done here? She has taken the highest estimated figure of 30 per cent. loss for gas, and the mean of the 10 and 15 per cent.—that is to say 12½ per cent.—loss on the *carefully* cooked joint in the electric-oven. Again we inquire why not have given figures for carefully cooked joints in both ovens—using the same temperatures, and cooking the meat to the same degree? Then we find Miss Little imitating the absurdity of some masculine predecessors in this field, by weighing up the hypothetical differences in weight, and crediting electric cooking with the saving at the cost price of the raw meat. She says, "there is thus a saving of 1¾ lbs. of meat by cooking in the electric oven, which, at 10d. per lb., means obviously a saving of 1s. 5½d." "Meat" denotes substance. There are more than 3 million gas-cookers in use in the country. Millions of pounds of meat are cooked in them in the course of the week; and the weight in the course of the year, if it could be obtained, would prove to be something marvellous. According to Miss May Little, 30 per cent. of "meat" escapes from these gas-ovens. Considering the specific gravity of meat, our roadways and housetops ought to be covered by a enormously thick coating of "meat." No one ought to go hungry. It should be there, electrically speaking, only waiting to be picked up. There is obviously something wrong about Miss Little's statement.

Some minor points invite criticism; but the major ones have already occupied much space. Our excuse is that we want to get full and proper explanations from Miss Little, as the authoress of the first book on "Simple Electric Cookery."

STATISTICS OF DUTCH GAS-WORKS.*

The statistics of the working results of gas undertakings in Holland for the year 1911 have just been issued in the customary form. They have been prepared, like the corresponding volumes for the two previous years, by de Heer P. Bolsius, the Manager of the Bois-le-Duc Gas-Works, de Heer M. van der Horst, of the Amsterdam Gas-Works, and de Heer G. A. Brender à Brandis, of The Hague Gas-Works.

The number of gas undertakings included in the present issue of these statistics is 150, as against 141 in the preceding issue. Some particulars are, however, given of five more small undertakings. The existence of 33 other gas-works in Holland is known; but these works have not supplied any information for inclusion in the statistics. They are all works of very small size.

The present volume of statistics is quite as exhaustive as its predecessors, and gives much fuller information in regard to gas undertakings in Holland than is afforded by the Board of Trade returns of gas undertakings or any other compilations relating to English works. On this account, it should prove valuable for reference in regard to questions of gas supply. In reviewing the previous issue, in the "Journal" for Sept. 17 last, p. 748, we gave an analysis of the figures included in the volume taken from a summary by de Heer N. W. van Doesburgh, of Leyden. It is unnecessary to give a similar summary again after so short an interval. It may be mentioned, however, that whereas no vertical retorts were shown to be in use in Dutch gas-works in 1910, the statistics for 1911 show that there were in that year three settings of vertical retorts at the Arnheim works.

There is one matter in which the statistics are less complete than similar statistics for other countries—viz., that no totals for the whole country are included in them. The labour which the compilers undertake in collecting and codifying the statistics for the volume is obviously so great that it is unreasonable to suggest that they should go further and conclude the volume with a summary giving totals for gas made, gas sold, coal carbonized, water gas made, number of public lamps, and a few other important items; but such a summary would increase the value of the statistics enormously, as it is from figures derived from a large number of works that the best impression is gained of the directions in which the gas industry as a whole is developing.

* "Statistiek Overzicht der Bedrijfsresultaten van de Gemeentegasfabrieken en eenige particuliere Gasfabrieken in Nederland in 1911." Bewerkt door P. Bolsius, 's-Hertogenbosch; M. van der Horst, W.E., Amsterdam; en G. A. Brender à Brandis T., 's-Gravenhage. Vertrouwelijke Mededeeling: C. N. Teulings, 's-Hertogenbosch; 1913.

Rusting of Iron.—A new chemical cause of the rusting of iron has been referred to in an article by Herr W. Vaubel in the "Chemiker-Zeitung." According to an abstract in the current number of the "Journal of the Society of Chemical Industry," ammonium nitrate attacks iron energetically—ferrous and ferric hydroxides being formed. The author has not observed the intermediate formation of nitrite. A part of the iron dissolves as a complexion which cannot be detected by ordinary reagents. Alkalinity hinders the reaction. These facts explain the variations in the amounts of iron, ammonia, nitrous acid, and nitric acid found in water which has been standing for different lengths of time in iron pipes. Calcium carbonate in water may have a restraining influence on the action of nitric acid or ammonium nitrate. A source of ammonium nitrate is nitrous acid observed by Bonnema to be formed by the action of air on ferrous and ferric hydroxides, and now confirmed by the author.

THE RELATION OF FLUE VENTILATION TO HEATING EFFICIENCY IN GAS-FIRES.

I.

By W. J. A. Butterfield, M.A., F.I.C., Assoc.Inst.C.E.

Towards the end of last year, the writer concluded an article dealing with the "Shadowgraph" test for gas-fires with the remark that he hoped subsequently to deal with some points bearing on the hygienic aspects of the escape of products of combustion in front of gas-fires.

At the time of writing that remark he had been approached by the Davis Gas-Stove Company with a proposal that he should make for them some further investigations by way of affording an independent check on research work which had been carried out in their laboratories. These investigations, which he undertook to make, aimed at determining, *inter alia*, the actual heat losses by way of the flue from a fire of the Company's make and from a fire of the same size made by another firm—both fires being tested under varying conditions of flue-draught. He agreed also to make a determination of the exact proportion of the total products of combustion which escaped in front of the fire made by the other firm when no flue was attached to it. The work involved was, however, postponed from time to time, owing to the writer being prevented by pressure of other work from giving the protracted personal attention which he considered necessary for investigations of this character. Some of the work has, however, now been completed, and the rest is well in hand.

In view of recent discussion in the pages of the "Journal," on points with which the writer's investigations deal more or less directly, it seems undesirable to wait for their completion before reporting the results already obtained. The writer will, therefore, proceed to describe the methods of investigation used by him up to the present, and point out their advantages and their limitations. He will also refer to the calculation of flue-gas losses from analytical results, with a view to assisting those who may for the first time be undertaking similar investigations in avoiding certain pitfalls and errors into which it is not difficult to fall. Finally, he will give the results obtained, with an indication of their degree of accuracy, and the manner in which they will be supplemented by the further investigations which he has in hand. Later he will prepare a report on the latter.

The results so far obtained are summarized in Table IV.; and the general conclusions from the work are given in the final paragraph of this article. The writer mentions this for the guidance of readers to whom the details given in the intervening paragraphs and the other tables are not of immediate interest.

The Fires Investigated.

The first series of investigations aimed at determining directly the effect of varying flue-draughts, as caused by varying lengths of flue-pipe, on the radiant efficiency, and on the heat losses by way of the flue of two gas-fires, of which one was a typical Davis fire—viz., a No. 1 "Apollo." The other fire would have remained unnamed in this article but for the fact that in recent reports by other investigators the names of certain competitive fires have been freely mentioned. Therefore there seems to be no ground now for reticence in respect of the second fire used, which was a Wright's 10-inch "Mascot." The two fires were chosen as typical and of equal size; and the investigations were started on them before it became known that other investigators had used the Davis "Vesta" and the Wright "Wizard" fires. Since the fire-front in these is similarly 10 inches wide, and the number of burners and general construction are the same as with the No. 1 "Apollo" and the "Mascot," the writer has adhered throughout to the latter fires, on which his work had been started.

The Measurement of Radiation.

The question of obtaining comparative measurements of the radiation of two gas-fires of the same size, in conditions of varying flue-draught, seemed to the writer to involve the use of a radiometer with which complete readings could be made fairly quickly. If a single radiometer test were to occupy many hours, there would be much greater risk of changes in external conditions (over which he could have little or no control) affecting the radiation or flue-gas losses from the fire.

The object of his investigations was to obtain strictly comparable results for the two fires in certain conditions which he could vary from time to time. He desired, therefore, to exclude as far as possible any variations due to atmospheric or other external influence. Having regard to rapidity of observation being essential to the object of his work, he preferred to use a radiometer which he found had been in use for some time past in the laboratories of the Davis Gas-Stove Company at Luton, to the radiometer which was devised by Professor W. A. Bone and Dr. J. Drugman, and was at their instance adopted by the Gas Heating Research Committee of the Institution of Gas Engineers. He was further inclined to take this view because the Bone-Drugman radiometer readings depend on a reference to, or comparison with, Professor R. H. Smith's radiometer, on which the radiometer in use at the Davis Gas-Stove Company's laboratories appeared to be an improvement. The latter radiometer—which had been devised by Mr. W. R. Twigg, the Technical Manager of the Davis Gas-Stove Company—resembles Professor Smith's radiometer in that it is a water-flow calorimeter; but it differs from it in that it is larger, and the absorptive surface or area is greater.

The Twigg radiometer consists essentially of a number of gilled tubes such as are used in many automobile radiators. These tubes are coated dead-black on the outside, and water circulates through them. The effective front of the radiometer is about 17 inches wide and 18¾ inches high, and contains a front row of seventeen gilled tubes, at the back of which is a second row of tubes joggled with the tubes of the front row. At the back of the tubes is a plain surfaced shallow tank, the front surface of which is blackened and the back is bright. Water flows in at an inlet, provided with a thermometer, at the back and near the bottom of the tank, up which it passes to the top of the back row of gilled tubes, down which it flows. At the bottom of these it passes into the front row of tubes, from the top of which it flows out through an equalizing chamber and outlet provided with a thermometer. In addition to the face of the radiometer as already described, there are, joined to it, two wings intended to collect the lateral radiation when the radiometer is placed in front of the fire. These wings have each an effective surface 2 inches wide and 18¾ inches high, and consist of a row of two vertical gilled tubes backed by the shallow tank. The tubes and tank of the wings are in the same water circulation with the body of the radiometer.

This radiometer, when placed in front of a 10-inch gas-fire, collects the whole of the radiation from the fire, except a small proportion which is directed upwards from the outer columns of "fuel," and a very small proportion which is directed laterally, or rather backwards, from the outside columns. So far as radiation upwards is concerned, that which is not collected by this radiometer can be of little practical service in room heating. It would only strike the ceiling; and it is, generally speaking, unnecessary and even undesirable to warm the ceiling of a room by direct radiation. Hence practically all the radiation which is not collected by this radiometer may be regarded as useless or perhaps even harmful for the practical heating of rooms. It should, however, be mentioned that, owing to the difference in the form of the canopies of the two fires, probably the proportion of the total radiation uncollected by this radiometer was rather greater with the "Mascot" than with the "Apollo" fire. But in either case the unmeasured radiation is not very considerable; and it is probably to some extent balanced by a small proportion of the convected heat from the fire being measured by the radiometer. So far as comparative tests between two fires of similar size are concerned, the results obtained with this radiometer seem to the writer to leave little to be desired.

Ultimately, he hopes to give a comparison between measurements of the radiation of gas-fires by a radiometer of this type and one of the thermopile type. At the present stage, he will only say that it appears to him that the latter instrument is liable to give readings which are in excess of the truth. The results of the radiometer readings in the principal series of tests are summarized in Table I.

Determination of Flue-Gas Losses.

The flue-gas losses were determined approximately in connection with the radiation tests; but determinations by more accurate methods are now in hand. In speaking of the determinations already made as giving only approximate results, the writer does not mean to say that these results are not comparable one with the other, but only that the absolute figures for the flue-gas losses in all cases might differ by some constant from results by the more tedious methods he has preferred to use in subsequent tests which are being made solely *ad hoc*.

The method used in the work now reported depended on the determination of the proportion of carbonic acid in samples of the flue gases as they emerged from the flue-vent or the top of the flue-pipe into the air of the room. The samples of the flue gases were taken at intervals in each test; and the mean proportion of carbonic acid found in them was used to calculate flue gas losses in that test. The samples were taken by aspiration into bottles with well-fitting stoppers; and the proportion of carbonic acid was determined by the Haldane volumetric method. The rate of consumption of the gas was measured in each test and corrected to normal temperature and pressure. The composition of the flue gases was then computed from the proportion of carbonic acid found in them, according to the general method described in the article on the "Shadowgraph" test already referred to. This method makes certain assumptions as to constancy of composition of the gas and of the air of the room. Actually the room was well ventilated. Its temperature averaged about 63° Fahr.; and there is no reason to suppose that the air supply to either fire at any time contained an abnormal proportion of carbonic acid or water vapour. In any case the conditions did not vary appreciably from one test to another; and the results for the two fires are therefore fairly comparable. The calorific power (both gross and net) of the gas was determined by a Boys calorimeter. It

ranged, during the day the principal series of tests were made, between 597 and 608 B.Th.U. gross, and 530 and 541 B.Th.U. net, per cubic foot.

The proportion of carbonic acid found in the flue gases and the temperatures observed are shown in Table II.

Computing the Composition of the Flue Gases.

The percentage of carbonic acid found by analysis of the flue gases is in reality the volume of carbonic acid in $(100 + x)$ volumes of flue gases, where x is the volume of water vapour appertaining to 100 volumes of dry flue gases when the products of combustion of the gas are diluted to the required degree with air of normal humidity. The formula given previously by the writer for computing the proportion of water vapour (A) in normal diluted products of combustion of gas from the proportion of carbonic acid (C) present in them is not directly applicable in cases where the carbonic acid has been determined by the ordinary methods and stated as a percentage by volume of the diluted products, exclusive of water vapour. The formula given previously is:

$$A = 1{\cdot}40 + 2{\cdot}383\ (C - 0{\cdot}03)$$
$$\text{or } A = 1{\cdot}3285 + 2{\cdot}383\ C.$$

When modified to apply to the usual case in which the percentage of carbonic acid (as determined by analysis) refers to 100 of flue gas exclusive of water vapour, this formula becomes:

$$A = \frac{132{\cdot}85 + 238{\cdot}3y}{100 + 2{\cdot}383y} \text{ or}$$
$$A = 100 - \frac{9867{\cdot}15}{100 + 2{\cdot}383y}$$

in which y is the percentage of carbonic acid found in the flue gases.

By the use of this formula and the formulæ given previously, the proportions of water vapour and of other constituents in the flue gases were calculated from the mean proportion of carbonic acid found by analysis of the samples of flue gases. The composition of the flue gases in each test, deduced in this way, is given in Table III.

Computing the Heat Capacity of the Flue Gases.

The composition of the flue gases having been computed in the manner described, the quantity of gases passing per hour through the flue-vent or flue-pipe was calculated from the ratio of the rate of consumption of the gas to the carbonic acid found in the flue gases. [Allowance was made for the small proportion of carbonic acid contained in the air with which the products of combustion proper are diluted.] The quantity of flue gases produced per hour in each test is shown in Table III. Being calculated by ratio of volume from a gas-rate per hour, stated in cubic feet at 60° Fahr. and 30 inches, the quantities of flue gases are likewise cubic feet at 60° Fahr. and 30 inches.

The heat capacity of the flue gases between the temperature of the air and gas from which they are produced and the temperature at which they are discharged from the flue-vent depends on the specific heats of the constituent gases. The specific heats of oxygen and nitrogen are practically constant over the range of temperatures here dealt with; but the specific heats of both carbonic acid and water vapour vary to an appreciable extent within this range. The following factors, deduced from the researches of Holborn and Henning and Holborn and Austin in 1905-07, have been adopted by the writer in calculating the heat capacity of the flue gases:

Mean Specific Heats under Constant Pressure for the Range of Temperature about 15° C. (t_0) to 150° to 240° C. (t_1).

Carbonic acid $= 0{\cdot}2014 + 0{\cdot}0000742\ (t_1 - t_0) - 0{\cdot}000000018 \times (t_1 - t_0)^2$
Water vapour $= 0{\cdot}448\ [1 + 0{\cdot}000096\ (t_1 - t_0)]$
Oxygen . . $= 0{\cdot}221$
Nitrogen . . $= 0{\cdot}239$

These specific heats are naturally in small calories per gramme per degree Centigrade; and from them the writer has calculated the heat capacity per degree Centigrade of 1 cubic foot of each gas at 60° Fahr. and 30 inches (or 15° C. and 760 mm.). The figures are:

Heat Capacity per Degree Centigrade of 1 Cubic Foot of Gases at 60° Fahr. and 30 inches.

Carbonic acid . . .	(0·051907 × specific heat) large calories
Water vapour. . . .	(0·021237 × specific heat) ,, ,,
Oxygen	0·007927 ,, ,,
Nitrogen	0·008335 ,, ,,

From these figures and the volumes and temperatures of the flue gases, the heat carried away by them was calculated. The result, stated in (large) calories per hour and in calories and B.Th.U. per cubic foot of gas consumed by the fire, is given for each test in Table III.

The Scheme of the Investigations.

The radiation measurements and the determinations of flue-gas losses incidentally carried out at the same time were made primarily in order to ascertain if the construction of fire represented by the Davis No. 1 "Apollo" (with which no products of combustion escape in front of the fire when no elbow or flue pipe is attached to the flue vent) was less efficient for heating purposes, in varying conditions of flue draught, than a fire which ceases to discharge its products of combustion in front only when the flue vent is connected to an appreciable length of flue-pipe, or is placed in front of a chimney with a pronounced up-draught.

In order that the flue-draught should be tolerably constant for each test, and exactly reproducible if a repetition of the test were desired, it was obtained by attaching an elbow and lengths of flue-pipe—of slightly greater cross-sectional area than that of the flue-vent—to the fire, which stood clear of walls or chimney

Table I.—*Radiometer Results.*

Fire.	Length of Flue Pipe (if any).	Corrected Rate of Gas Consumption, Cubic Feet per Hour.	Radiation Measured. B.Th.U. per Cubic Foot of Gas Consumed.	Calorific Power of Gas. B.Th U. per Cubic Foot. Gross.	Net.	Radiation per Cent. of Net Calorific Power of Gas.
"Apollo" .	No elbow or flue-pipe	25·65	231·5	603	535	43·24
"Mascot" .	,,	25·20	229·6	603	535	42·90
"Apollo" .	4 ft. 9 in.	25·50	222·4	605	538	41·38
"Mascot" .	,,	24·90	220·4	604	536	41·14
"Apollo" .	6 ft. 9 in.	25·50	220·6	603	535	41·26
"Mascot" .	,,	25·20	222·0	608	541	41·08

Table II.—*Observations on Flue Gases.*

Fire.	Length of Flue-Pipe (if any).	Mean Percentage of Carbonic Acid in Flue Gases (exclusive of Water Vapour) at Flue-Vent or Top of Flue-Pipe.	Mean Temperature of Flue Gases at Flue-Vent.	Excess of Temperature of Flue Gases over Temperature of Room Air.
			Deg. Fahr.	Deg. Fahr.
"Apollo" .	No elbow or flue-pipe	3·08	457	391
"Mascot" .	,,	2·44	420	356
"Apollo" .	4 ft. 9 in.	1·49	379	313
"Mascot" .	,,	1·13	314	251
"Apollo" .	6 ft. 9 in.	1·26	359	293
"Mascot" .	,,	1·04	292	229

Table III.—*Flue-Gas Losses.*

Fire.	Length of Flue-Pipe (if any).	Composition of Flue Gases. Per Cent.		Volume of Flue Gases. Cubic Feet (60° F. and 30 In. per Hour).	Heat Carried by Flue Gases at the Temperature of Discharge from the Flue-Vent.	Heat Carried by Flue Gases per Cubic Foot of Gas Consumed.
					Calories.	Cals. B.Th.U.
"Apollo"	No elbow or flue-pipe	Carb. acid	2·83	12·96	31·6	
		Water vap.	8·07	36·94	77·9	
		Oxygen	14·22	65·10	117·8	
		Nitrogen	74·88	343·00	590·0	
			100·00	458·00	817·3	31·89 = 126·5
"Mascot" *	,,	Carb. acid	2·28	12·79	28·3	
		Water vap.	6·75	37·91	72·8	
		Oxygen	15·48	87·00	143·6	
		Nitrogen	75·49	424·30	666·0	
			100·00	562·00	910·7	36·11 = 143·3
"Apollo"	4 ft. 9 in.	Carb. acid	1·42	13·02	25·1	
		Water vap.	4·71	43·18	72·7	
		Oxygen	17·45	160·00	232·2	
		Nitrogen	76·42	700·80	966·0	
			100·00	917·00	1296·0	50·78 = 201·5
"Mascot"	,,	Carb. acid	1·09	12·80	19·7	
		Water vap.	3·93	46·15	62·3	
		Oxygen	18·21	213·75	250·0	
		Nitrogen	76·77	901·30	1000·0	
			100·00	1174·00	1332·0	53·44 = 212·0
"Apollo"	6 ft. 9 in.	Carb. acid	1·21	13·09	23·6	
		Water vap.	4·21	45·55	71·7	
		Oxygen	17·93	194·00	263·6	
		Nitrogen	76·65	829·36	1071·6	
			100·00	1082·00	1430·5	56·03 = 222·3
"Mascot"	,,	Carb. acid	1·00	13·00	18·0	
		Water vap.	3·71	48·25	59·0	
		Oxygen	18·41	239·35	254·0	
		Nitrogen	76·88	999·40	1006·0	
			100·00	1300·00	1337·0	53·10 = 210·7

* The figures for volumes of flue gases and the heat losses calculated therefrom have been throughout deduced on the assumption that all the products of combustion of the gas pass through the flue-vent, which assumption is incorrect with this fire without flue-pipe.

TABLE IV.—*Distribution of the Heat per Cubic Foot of Gas Consumed.*

Length of Flue-Pipe (if any).	No Elbow or Flue-Pipe.				4 Ft. 9 In.				6 Ft. 9 In.			
Fire.	"Apollo."		"Mascot."		"Apollo."		"Mascot."		"Apollo."		"Mascot."	
	B.Th.U.	Per Cent.	B.Th.U.	Per Cent.	B.Th.U.	Per Cent.	B.Th.U.	Per Cent.	B.Th.U.	Per Cent.	B.Th.U.	Per Cent.
Radiation measured	231·5	43·24	229·6	42·90	222·4	41·38	220·4	41·14	220·6	41·26	222·0	41·08
Flue-gas losses determined	126·5	23·63	143·3*	26·78*	201·5	37·49	212·0	39·59	222·3	41·56	210·7	38·98
Convection, conduction, unmeasured radiation, &c. (by difference)	177·5	33·13	162·1*	30·32*	113·6	21·13	103·1	19·27	92·1	17·18	107·8	19·94
Net calorific power of gas	535·5	100·00	535·0	100·00	537·5	100·00	535·5	100·00	535·0	100·00	540·5	100·00
Proportion of heat of gas rendered available for heating the room (total heat less flue-gas losses)	409·0	76·37	391·7*	73·22*	336·0	62·51	323·5	60·41	312·7	58·44	329·8	61·02

* These figures are not correct, for the reason given in the foot-note to Table III.

in a well-ventilated room. For convenience in making the radiometer readings, the fire was mounted on a stand about 18 inches from the floor-level. The length of flue-pipe stated in the various tables is the vertical height from the top of the flue-pipe to the horizontal plane through the centre of the flue-vent.

The results of the radiometer observations on the two fires, each in three different conditions of flue-draught, for the principal series of tests (which were all carried out in one day) are given in Table I. It will be seen from them that the "Apollo" fire is, if anything, more efficient, so far as radiation is concerned, than the other fire in all the conditions of draught tested. Further, from the trend of the figures, there seems no ground for supposing that a greater draught than that produced by 6 ft. 9 in. of flue-pipe would reduce the radiation from the "Apollo" fire to a greater extent than from the other fire. In respect of radiation, therefore, the "Apollo" construction is certainly at no disadvantage.

The difference in design of the two fires and the difference in cross-sectional area of the flue-vent (which area is less in the "Apollo" than in the other fire) causes the flue gases to be discharged from the flue-vent, in all conditions of draught, at a higher temperature and with a higher content of carbonic acid with the "Apollo" than with the other fire in the same conditions. This is shown by the figures given in Table II. But the volume of flue gases is correspondingly less with the "Apollo;" and consequently there is no greater loss of heat by way of the flue in most conditions with the "Apollo" than with the other fire. It will be seen from Table III. that, with no flue-pipe and with 4 ft. 9 in. of flue-pipe, the flue-gas losses were found to be distinctly lower with the "Apollo" than with the other fire, though with 6 ft. 9 in. of flue-pipe, the "Apollo" shows larger flue-gas losses.

The writer wishes particularly to deprecate any suggestion that the differences shown in the flue-gas losses as between the one fire and the other have any great significance. The differences are in most cases of an order which the assumptions necessarily made in arriving at these figures from the data available might cause between tests of the same fire made on different days. But he feels fully justified in inferring from the results, taken as a whole, that flue-gas losses in most conditions are no greater with the "Apollo" than with the other fire.

The investigations which he has in hand should enable him to pronounce positively as to the relative flue-gas losses of the two fires.

General Heating Efficiency.

The results of the radiometer observations and of the calculations of flue-gas losses are summarized in Table IV. The difference between the net calorific power of the gas consumed and the radiated heat *plus* the flue-gas losses must represent the heat given out by the fire by convection, conduction, and any radiation which has escaped measurement by the radiometer used. It thus becomes possible to calculate the approximate total heating efficiency (by radiation and convection, &c.) of the two fires; and the figures so found are included in Table IV. It will be seen that the total heating efficiency of the "Apollo" fire is in most conditions as high as, or even higher than, that of the other fire.

The figures for the latter fire without a flue-pipe are not altogether trustworthy, because it has been assumed, in calculating the volume of flue gases, that none of the products of combustion of the gas escape in front of the fire. Since actually a considerable volume of products of combustion does escape in front of this fire when it is used without a flue-pipe or other draught-inducer, the volume of flue gases has been over-estimated in this case. The flue-gas losses would be lower than shown, in virtue of the escape of products of combustion in front of the fire. Exactly how much lower, however, is a point reserved for further investigation, as is also the determination of the precise length of flue-pipe requisite with this fire to effect the removal of the whole of the products of combustion through the flue-outlet. When the length of flue-pipe has been ascertained precisely, the reduction of the total heating efficiency of the fire which results from its addition will be ascertained. It is obvious, however, that the total heating efficiency of the "Apollo" fire without a flue-pipe is very much greater than that of the other fire with a length of flue-pipe sufficient to render it equal to the "Apollo" fire in respect of the complete removal of the products of combustion through the flue-outlet.

Conclusions.

The investigations, of which the results have been reported above, have been made in comparable conditions for the two fires. They are conclusive on one point of fundamental significance. That is to say, they show that the type of construction represented by the Davis No. 1 "Apollo" fire is certainly not inferior in radiation efficiency to the other fire examined, even when a strong draught is applied to the flue-vent; while the total heating efficiency is about the same. The figures also show that there is no ground for the fears expressed, that a reduced heating efficiency will necessarily result if gas-fires are constructed so that, when unaided by flue-draught, they discharge the whole of their products of combustion through the flue-vent. The fact that a fire passes the "Shadowgraph" test when it is tested without elbow or flue-pipe does not, therefore, imply that it will in any ordinary conditions of use have a lower heating efficiency than even the most efficient fire which fails to pass the test. The heating efficiency appears to be determined by factors which are not affected by the proper application of the principles involved in the type of construction represented by the Davis No. 1 "Apollo" fire and other fires of its class. Consequently, there is no good reason why all makers should not apply these principles to the gas-fires which they manufacture. If this were done, the gas consumer and the gas industry would have the assurance that the risk of products of combustion escaping in front of a fire was reduced to a minimum; while there would be no sacrifice of heating efficiency, provided the principles referred to were applied as judiciously as in the Davis "Apollo" class of fires.

Presentation to Mr. Harold W. Bloor.

On Friday, the 11th inst., Mr. Harold W. Bloor, who has relinquished the management of the Carlisle Gas-Works, on being appointed Engineer, Manager, and Secretary of the York Gas Company, was the recipient of a handsome suit-case, attaché case, and "Thermos" flask, subscribed for by the staff and workmen. The presentation was made by Mr. Lowther Nicholson, the Assistant Manager, who said the gifts were offered as a slight token of the esteem in which Mr. Bloor was held. Mr. J. Birkett, speaking for the office staff, said that while it gave them pleasure to think that Mr. Bloor had been selected out of a large number of candidates for the position he was about to occupy, they sincerely regretted losing him. Since he had been in Carlisle, he had increased the consumption of gas from 310 to 356 million cubic feet; and this, of course, had been a benefit to the works under his charge. Mr. T. Birkett (Works Foreman) and Mr. J. J. Routledge (Distribution Foreman) also made complimentary references to Mr. Bloor's character and ability, and expressed the regret felt by all at his leaving Carlisle. Mr. Bloor feelingly acknowledged the gifts, and paid a warm tribute to the staff for the services rendered by them, and for the loyal support he had always received. He concluded by wishing the assembled company every success in the future. Mr. Bloor then introduced Mr. E. G. Hutchinson, the new Engineer and Manager, who offered a few remarks, and was accorded a hearty welcome.

Memorial to Lord Kelvin.—As the result of action taken by engineers in the British Dominions and the United States, a window in memory of Lord Kelvin has been placed in the North Aisle of Westminster Abbey, in close proximity to one to the memory of Sir Benjamin Baker subscribed for by civil engineers, and designed by the same artist (Mr. J. N. Comper). It was dedicated in the presence of a large congregation, at a special service held last Tuesday afternoon.

Increased Railway Rates on Coal and Coke.—It will be remembered that, as the result of the passing of the Railways Bill, the railway companies announced increases in the rates for the carriage of merchandise—the advance amounting to about 4 per cent.; and they came into operation on the 1st inst. Coal and coke were, however, exempted, except on the Scottish systems. But we learn from the "Iron and Coal Trades Review" that the English systems have now followed the Scottish example, and on Monday last week some of the most important companies gave notice of increases in rates for conveying coal and coke from collieries in Derbyshire and Nottinghamshire to nearly two hundred destinations. The increase—varying from ½d. to 3d. per ton—is to come into operation on Sept. 1 next.

THE "LUX" GAS-CONTROLLER.

THE advantages of the automatic control of street-lamps have received such a large amount of confirmation, that nowadays there is not much, if any, need to make a point of them. The number of these controllers is extending; and out of the number those that experience shows to be the best will survive. Of course, this is essentially a class of apparatus that cannot be judged only on structural or working features; trial alone must decide efficiency.

A new controller has been produced by the Aktiebolaget Lux, of Stockholm, Sweden; and the exploitation of it has been undertaken in this country by Messrs. Henry Roper and Co., of No. 4, Lloyd's Avenue, London, E.C., which firm has brought it to our notice. It takes its place in the class of appliances operated by pressure-waves from gas-works. In this country a few samples of the appliance are already under trial; and it will assure interest in it if we mention that in Gothenburg some 3400 street-lamps—practically the whole of the public incandescent gas-lamps—are fitted with the apparatus; and there, as in other Scandinavian towns, the results, we are informed, have been highly satisfactory. The extent of the Gothenburg experience is of great value as a recommendation to trial in other places. The main feature on which the "Lux" controller claims consideration is that it has been successfully designed to obviate the difficulties due to varying pressures and levels that have been discovered by experience—difficulties which were, in fact, only discoverable by practical day-by-day experience, and which have produced untoward incidents, such as the lighting-up of lamps at the wrong time. In the case of the present controller, it is understood that reliable action has been obtained by means of an air cushion, the duty of which is to prevent the direct action of the gas pressure on the moving gear, and to render the latter subject only to the influence of a pressure-wave of definite duration and definite height. Here the claim is at once revealed by which this new controller hopes to gain a place in favour among public lighting authorities.

The attributed fitness of the controller under quite a large range of variability in condition is great; but it is a matter that can easily be put to the proof of test. With it, an adjustment from a particular pressure is dispensed with; the apparatus being, it is said, capable of working equally well within a range of pressure of 2¾ inches. It can only be put into action by pressure-waves produced in a prearranged manner, and lasting for a definite time. For instance, it is gathered that the apparatus can be so regulated that it will operate only under an excess of pressure of at least ½ inch, with the accompanying provision that the over-pressure shall be reached in less than two minutes, and be maintained during at least another two minutes. Thus adjusted, there will be no action upon the gas-valves even under an over-pressure of ½ inch or more if the duration of such over-pressure is, for example, only half a minute. Again, the same over-pressure will have no action on the valves if it has taken ten minutes to produce. In short, the valves, we are told, are not subject to the action of an excess of pressure if the latter has not been purposely produced in a certain manner and in a certain time. Within the previously mentioned range of 2¾ inches, any modifications of pressure may, therefore, take place in mains

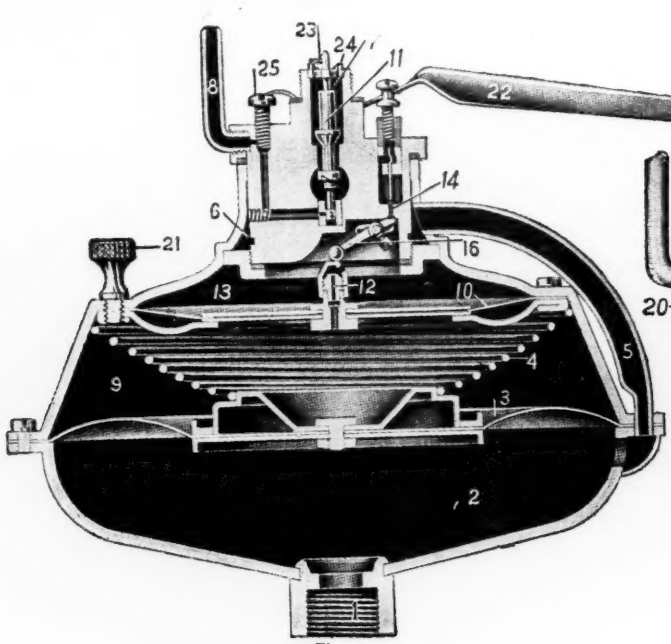


Fig. 1.

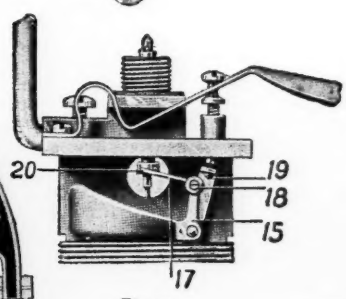


Fig. 2.

Fig. 3.

communicating with street or other lamps fitted with the controller, without putting the latter into operation, provided care is taken that such modifications be not exactly the same as those under which the apparatus is expected to work. If these claims are substantiated by experience in this country, the controller should have a good future.

In view of these claims, interest will be taken in a brief reference to the construction. Outwardly (as the illustration, fig. 3, shows) we have a metal casing, the greatest external diameter of which is 5½ inches, and the extreme depth from the connecting points 5 inches. In this casing there are two diaphragms and a mechanism acting on the valves. The latter is fitted into the former, from which, however, it can be easily removed. The two diaphragms divide the box into three compartments—the lower one for gas, and the two upper ones for air. The way in which the gas-pressure acts on the diaphragms and mechanism working the valves, is illustrated—fig. 1 giving the section of the entire apparatus, and fig. 2 of the operating mechanism separately. The gas arriving through the inlet 1 (fig. 1) into the gas chamber 2, presses on the diaphragm 3, on top of which is a spiral spring which keeps it balanced at the ordinary gas pressure. From the chamber 2 the gas reaches, through the passage 5, compartment 6, which contains the operating mechanism. Thence it is directed either to the burner-jet through the passage 7, or through the passage 8 to the pilot-jet. When the spindle of the valve is placed so as to leave open the passage to the pilot-jet, the main passage way is closed. To light the gas, an extra pressure amounting to about ½ inch is applied, but such increase must be obtained in less than two minutes, and the extra pressure must be maintained at its maximum level for at least three minutes. The extra pressure moves the diaphragm 3, causing compression of the spiral spring 4, and of the air contained in the compartment 9. As a consequence, the upper diaphragm 10 is moved upwards, lifting, in its turn, the operating mechanism, which engages with the spindle 11 of the valve, turning the latter so as to open the passage-way to the burner. Such opening, however, can only take place when the upper diaphragm returns into its normal position, owing to reduction of the gas pressure, or to the escape of air through the passage 12. The valve, when so turned, shuts off the supply of gas to the pilot-jet. Thus the extra pressure causes the pilot-flame to light the burner, and simultaneously to extinguish itself.

If the extra pressure of ½ inch has not been obtained within the time fixed, no change can take place in the position of the operating mechanism, because the compressed air of the lower compartment 9 has time to escape through the narrow passage 12, which passes through the centre of the diaphragm 10. Owing to the escape of air, this diaphragm remains unmoved although the lower one may have been expanded even more than enough. If, on the contrary, the extra pressure has been produced too quickly, and has not been sustained long enough, the diaphragm will from another cause be unable to act on the operating mechanism. In this case the resistance of the air contained in the upper compartment 13 will be too strong; and this resistance, must be weakened by the escape, during a sufficient time, of air through the passage 14. The valve is guided by the two combined levers 15 and 16, and by the pawl 17 (fig. 2), which has to travel the whole length of one of the teeth of the ratchet wheel before acting upon the valve. The power and the duration of the extra gas pressure must be calculated to obtain this effect. If the extra pressure has not been able, in the time assigned, to lift the upper diaphragm to a sufficient height, a continuation of the pressure will not pre-

vent the diaphragm, together with the levers and the pawl, from returning into their normal positions, because the air compressed by the lower diaphragm will gradually escape through the passages 12 and 14, instead of conveying the pressure to the upper diaphragm and the operating mechanism. Whenever the extra pressure has lifted the levers 15 and 16 to a level where the pawl 17 can act upon the rachet wheel fixed on the valve, there is a possibility of turning the latter, with the result of either lighting or extinguishing the lamp. In many cases, however, it is desirable not to simultaneously light or extinguish all the lamps—after a late hour, for instance, in most places only half the number of lamps are kept burning. It is therefore advisable to possess the power of turning the valve, without each time effecting the ignition or extinction of the lamp. To achieve this, the cones underneath the ratchet-wheel on which, when uplifted, the valve reposes, are made of various lengths and with various intervals. By this arrangement, the apparatus can be made to work, so that, for instance, the first application of extra pressure produces the lighting of those lamps that are placed in the part of a town that most needs light, the second application lights all the other lamps, the third extinguishes half the number, and the fourth the remaining half of the lamps. The screw 19 comes into use only in the installation of the apparatus, and serves to quickly let out the air which the turning on of the gas has compressed. The rod 20 serves the sole purpose of facilitating at the time of installation the adjustment of the operating mechanism.

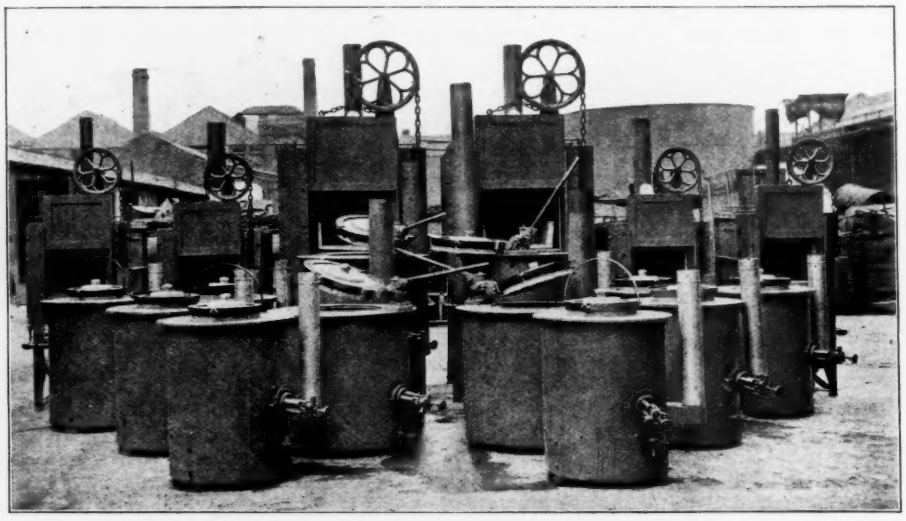
The cycle of working of the apparatus by which the variable circumstances of gas-distribution service are met is very interesting. It appears to give a double line of protection against troublesome occurrences. When there has been sufficient experience in this country with the controller, we shall be pleased to receive further information in reference to it; for it is necessarily only upon actual working experience that positive recommendation can be made.

GAS FOR METALLURGICAL PURPOSES.

A Big Battery of Furnaces.

In the final number of the "Journal" published last year, some space was devoted to describing and illustrating a gas-heated sugar boiler patented by Mr. L. F. Tooth, of the Commercial Gas Company; and it was stated that, in addition to the large installation at Maidstone then specially referred to, boilers of the same type had been fitted up in various large factories in London and other parts of the country. Much time had been devoted by the inventor to the perfecting of this particular appliance, for it seems that sugar boiling for the confectionery trade is an operation that requires to be carried out with a great degree of precision. Nevertheless, Mr. Tooth at the same time found—or made—opportunity to actively pursue his investigations in connection with the utilization in other directions of high-pressure gas. In fact, its employment for metal smelting formed the subject of the address which he delivered, at the end of 1910, to the London and Southern District Junior Gas Association, during his presidency; and when, some few months later, the members visited the Stepney works of the Commercial Gas Company, they saw in operation both burners and furnaces constructed in accordance with patents taken out by their President. Knowing that since then much work had been done, the writer visited Stepney, so as to put himself in possession of the latest information.

That at the Stepney Gas-Works they were able to make good fittings, visitors have already had an opportunity of satisfying



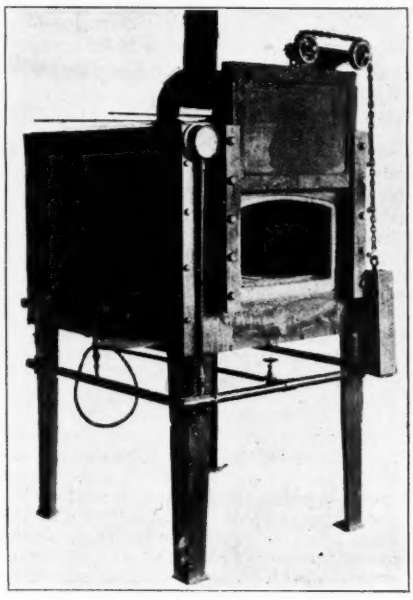
A Battery of Eighteen High-Pressure Gas-Furnaces.

themselves; and now it is being demonstrated that they can make good furnaces as well. In proof of this, reference may be made to the accompanying photograph of a large battery of eighteen furnaces, of different sizes and shapes, all of which have been manufactured on the works by the Commercial Gas Company, for Messrs. Rothschilds' Royal Mint Street Refinery, to be used for melting bullion. The bricks employed for the furnaces are made to the specification of Mr. Tooth, who has done a good deal of work in connection with refractory materials, owing to the fact that gas firing has a different effect from that of any other form of fuel. Some brickwork was seen which had been fired by means of gas-furnaces. This brickwork had been under fire for twenty-four hours, and gradually raised to a temperature of 1450° C. The Tooth melting furnaces are made in all sorts of sizes—from 5 lb. charges upwards—and several of them were seen in course of construction. On the works, a series have been installed in a building specially set aside for the purpose of carrying out practical demonstrations for the benefit of inquirers, of whom there have been many. In the Commercial Company's district, of course, there is a big opening for economical appliances suitable for metal refining, melting, casting, and such like operations. Then another type of furnace inspected (now in the development stage) is intended for rivet, angle iron, and bar heating; while other directions in which Mr. Tooth is casting his eyes are oil and varnish boiling, and the building of a 3-ton lead melting furnace, and a very big one for the cupellation of silver.

The muffle-furnaces are built of segmental bricks. With the larger sizes, fourteen pieces of brickwork in all are employed; and for the smaller ones, eleven pieces. They are fitted with regenerative flues, and a particular form of combustion chamber, which is the reason for the uniform temperature attained throughout the whole of the muffle. In the larger sizes of muffle-furnaces, a temperature of 1000° C. can, it is said, be reached in one hour and twenty minutes, and with the smaller ones in an hour—the dimensions and gas consumptions per hour being as follows: Furnaces 3 feet deep, 2 feet wide, and 18 inches high, 280 cubic feet; 3 feet deep, 2 feet wide, and 15 inches high, 250 cubic feet; 2 ft. 4 in. deep, 1 ft. 5 in. wide, and 11 inches high, 180 cubic feet; 1 ft. 5 in. deep, 1 ft. 5 in. wide, and 11 inches high, 110 cubic feet; and 1 foot deep, 10 inches wide, and 7½ inches high, 80 cubic feet. It is found that the most economical pressure at which to supply the gas for this temperature is 6 lbs. These gas consumptions can be reduced 15 per cent. after the first hour to an hour-and-a-half of working. If higher temperatures than 1000° C. are required, all needed is to increase the pressure. Temperatures as high as 1400° C. have been recorded in the muffles.

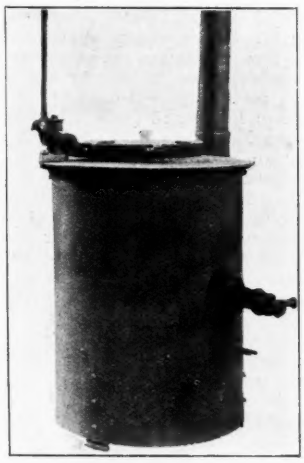
As to the metal-melting furnaces, these are at present made in four sizes; the one illustrated being the 150 to 200 lb. size. With these furnaces, experience shows that the best pressure at which to supply the gas is 10 lbs.; and a temperature of 1400° C. can be reached within 1¼ hours. For the benefit of the writer, a charge of 45 lbs. of best hard brass was placed in one of the furnaces, and melted in 21 minutes; the total gas consumption being stated as 60 cubic feet. It has been found in ordinary practice in a brass foundry working on a nine-hour day, that it is possible to turn out twenty-five 40 to 60 lb. charges per day, with a gas consumption of 1400 to 1500 cubic feet. This includes the time taken in pouring metals and refilling, during which operations it is found to be economical to reduce the pressure, and so save gas consumption. Starting with a cold furnace, it has been

proved that from 40 to 50 lbs. of brass can be melted down ready for pouring within an hour and ten minutes. In fact, to put the matter shortly, Mr. Tooth claims that he can melt brass at a cost of from 3½d. to 4d. per cwt. with gas charged out at 1s. 10d. per 1000 cubic feet.



A High-Pressure Muffle Furnace.

Two patterns of burners are employed. The three-tube form used for the melting-furnaces is particularly quiet in action. The three tubes, through which the gas passes, meet in a cylinder, having inside it a cone, by means of which regulation of the air is afforded—the cone being merely screwed in or out as desired. The other type of burner, used for the muffle-furnaces, nearly resembles in the body a snail; its shape giving a rotatory action to the air and gas for the purpose of securing a perfect mixture. This action, of course, makes the burner somewhat noisier than the three-tube pattern. Regulation is secured in the same way by a cone. The burners have been designed for application to all



A 150-lb. High-Pressure Melting Furnace.

kinds of industrial purposes; and if it is desired to remove the combustion a distance away from the nozzle, this can be accomplished by the aid of the air-valve or cone referred to.

A point about certain sizes of the melting-furnaces is that they are fitted with a compact and simple lifting arrangement. By merely drawing a lever into a horizontal position, the cover of the furnace is raised and set in its raised position, and can then be swung clear to permit of the removal of the pot. One final word as to the muffle-furnaces. These can be raised to very high temperatures indeed; and, with regard to the important point of uniformity of heating, the assurance is given that pyrometer tests have indicated that in practical use there is not more than 10° C. difference between the temperatures of every part of the furnace. The hope may be expressed that the battery of furnaces shown in the photograph will, when in operation at Messrs. Rothschild's refinery, prove entirely satisfactory to all parties—to the firm using them, to the Commercial Gas Company, and to Mr. Tooth, whose hard work merits this reward. As a matter of fact, experience already gained leaves no room to doubt success.

LEEK GAS-WORKS EXTENSIONS.

At the recent meeting of the Institution of Municipal and County Engineers, which was held at Leek, a paper descriptive of "Leek and its Municipal Works" was read by Mr. W. E. Beacham, Surveyor and Water Engineer to the Urban District Council. The contribution was a lengthy one, and dealt with, among other matters, gas, water, and electricity supply and sewerage and sewage disposal. The remarks on the gas supply were as follows:

In the year 1828, the town was supplied with gas; the works having been built in 1826 by a joint-stock company. The price for gas was 12s. 6d. per 1000 cubic feet, which, though it may be considered high, was less than was paid in Manchester at the time—viz., 14s. In the year 1845, the Commissioners, under the old Act, purchased the works for £6194; and under the 1855 Act, they became vested in the Improvement Commissioners—the price of gas being then 6s. per 1000 cubic feet, and the annual make 3½ million cubic feet. Since then the works have been considerably enlarged; and in the year 1898-9, consequent upon the increased demand, the whole works were rebuilt, on the most up-to-date principle, at a cost of £20,000. The annual make of gas has increased to 109 million cubic feet; and the net price to consumers is now 2s. 2d. per 1000 feet. Up to the year 1910 the streets were lighted free, and considerable sums handed over to the rates, though no charge is made for meters, and services are laid up to the houses free. Since 1903, the author has been responsible for extensions to the retort-house and coal-store, the erection of coal-handling plant buildings, including a subway under the county main road, and new offices, the latter having just been completed; and it is claimed that the town possesses one of the most up-to-date gas undertakings in the county.

Previous to the putting down of the up-to-date coal-handling plant, the coal used for gas making—about 10,000 tons per annum—was carted from the railway company's sidings to the works, and then by means of a winch was taken up an inclined way to the coal-store. It was only possible then to buy gas nuts; and the cartage was considerable, averaging 1s. a ton, as each load had to be weighed over the machine when passing into the works. It was originally intended to have an overhead transporter or conveyor; but in 1902 this idea was abandoned in favour of an underground one. The author, in conjunction with Messrs. W. J. Jenkins and Co., of Retford, the plant contractors, prepared plans, &c.; and the work was eventually carried out as follows: The railway company's sidings were continued to a site adjoining the coal-breaker pit; and now each truck is weighed as it comes in, and again empty as it goes out. The truck passes on to the edge of the pit, where a tipper, worked by a 22-H.P. gas-engine, comes up, and, catching the truck under the back axle, tips the contents into a hopper. The coal then passes through a breaker, where it is reduced to sizes suitable for gas making, and discharged on to an endless Balata belt, which travels up through a subway constructed under the main road from the Potteries to Leek, into the gas yard, and thence to the top of the coal-store.

The gas-engine works a capstan for moving the trucks from the siding over the weighing-machine, and to the breaker-pit, the tipper, breaker, and belting, and thus effects a great saving of labour in handling. The breaker-pit is 20 feet deep, built of Staffordshire blue bricks in cement; and the subway is 6 ft. 6 in. wide by 6 feet high, the side walls being 14 inches thick, with a semi-circular three-ring arch. The inclination of the subway is 1 in 2·4. The floor is of portland cement concrete, with strengthening cleats every 15 feet apart. A flight of steps is formed in the concrete on one side of the subway, leaving sufficient room for the standards supporting the rollers carrying the belting, so as to afford facilities for oiling the roller-bearings and give access to the plant from the gas-works yard, without coming out of the works.

An engine-house encloses the gas-engine, which is one of the "National" type; and a corrugated roof with steel framing covers the breaker-pit and belting, from the outlet of the subway in the gas yard up to the coal-store roof level. The plant has been in use since 1907, and must have effected a great saving in coal handling, as it enables the Council to buy coal in the open market, and do their own crushing, and in conjunction with the appliances, such as conveyors and mechanical stokers, provided at the works, forms a complete system of coal-handling machinery. The cost of the plant and buildings amounted to £2650.

The new gas offices adjoining the works, which have just been completed, contain on the ground-floor weighing-machine, attendant's office, waiting-room, general office, and lavatory, and on the first floor the manager's private office, laboratory, and photometer room. They are built with Accrington facing bricks and Roche stone dressings, and cost £625.

According to the provisional programme for the forthcoming meeting of the British Association, Professor Burstall will read a paper dealing with "Solid, Liquid, and Gaseous Fuel" before the Engineering Section.

The friends of Mr. Thomas May, Assoc.M.Inst.C.E., the Engineer and Secretary of the Richmond (Surrey) Gas Company, will learn with regret that he has just sustained a bereavement by the loss of his fifth son (Alan), which occurred at "The Poplars," Richmond, last Wednesday.

OXIDE OF IRON PURIFICATION IN SULPHATE OF AMMONIA WORKS.

Action of Sulphuretted Hydrogen on Hydrated Oxide of Iron.

In the notice of the last report of the Chief Inspector under the Alkali Acts which appears elsewhere, reference is made to the further experiments carried out in the past year on the above-named subjects. It will no doubt be remembered that during the year 1911 a considerable body of data was collected with respect to the conditions controlling the oxide of iron purification process in sulphate of ammonia works, with a view to elucidating the cause of what is known as "souring," and to determining the factors that control the efficiency of the oxide in works where sulphiding and revivification proceed on normal lines. The results of this research were fully set out in the annual report for 1911, and were noticed in the "JOURNAL" [see Vol. CXIX., p. 324]; but, in view of the importance of the subject, it will not be out of place to briefly summarize here the more important conclusions arrived at, before proceeding to discuss the results obtained by the further study of the subject.

Three factors were found to control the efficient working of the oxide of iron purifying process to a marked extent—

(1) *Hydration.*—A relatively highly hydrated oxide absorbs a greater weight of sulphuretted hydrogen before allowing gas to escape unabsorbed than the same oxide in a less hydrated form. Hydrated oxide, dried at 100° C., approximates in composition to the monohydrate—$Fe_2O_3.H_2O$. On exposure to air containing water vapour, moisture is absorbed; on the other hand, a moist oxide loses moisture on exposure to dry air. Bog iron ore or revivified oxide partially dried at 25° C. (77° Fahr.), and containing about 10 per cent. of moisture, is in a very suitable condition for sulphiding.

(2) *Temperature.*—The temperature most favourable for maximum absorption of sulphuretted hydrogen, either with or without admission of air, lies in the neighbourhood of 60° C. (140° Fahr.). Oxide fouled at about this temperature in the laboratory gives the maximum yield of free sulphur, and a minimum of sulphur in other forms. At higher temperatures, soluble salts of iron and an increasing amount of disulphide (FeS_2) are formed. The presence of ferrous sulphate and disulphide appears to confer upon the high-temperature products the peculiar properties associated with the word "sour;" the oxide being then very inert towards sulphuretted hydrogen, and at the same time showing little or no tendency to revivify on exposure to the air after fouling.

(3) *Air.*—Presence of air (in the ratio of 2 vols. of air to 1 vol. of H_2S) increases the efficiency of the oxide at all temperatures, and is favourable to the formation of free sulphur and unfavourable to that of ferrous sulphate when an excess of sulphuretted hydrogen is present.

The following equations were submitted as explanatory of the sulphiding and oxidation stages in the purifier:—

Sulphiding Stage.

1.—$Fe_2O_3 + 3H_2S = F_2S_3 + 3H_2O$.
2.—$Fe_2O_3 + 3H_2S = 2FeS + 3H_2O + S$.
3.—$FeS + S = FeS_2$.
4.—Interaction, in part, of Fe_2O_3 with Fe_2S_3, FeS, or FeS_2 to form $FeSO_4$.

Oxidation Stage.

1.—$Fe_2S_3 + 3O = Fe_2O_3 + 3S$.
2.—$2FeS + 3O = Fe_2O_3 + 2S$.
3.—Interaction of FeS_2 with oxygen to form $FeSO_4$ and SO_2. Interaction of SO_2, air, and moisture in contact with hydrated oxide to form free sulphuric acid and ferric sulphate.
4.—Interaction of $FeSO_4$ with hydrated oxide and air to form basic sulphates insoluble in water.

A preliminary study of the conditions prevailing in purifiers in actual sulphate of ammonia works practice, however, failed to yield any data from which to draw reliable conclusions with respect to the cause of "souring" in general. As regards the cure for sourness, alternate treatment of the moist material with alkali or alkaline earth and exposure to air is found effective.

The laboratory results summarized in the report for 1911 were obtained by treating hydrated oxide of iron (bog ore) with sulphuretted hydrogen diluted with carbon dioxide, or with carbon dioxide and air, in a U-tube, and under conditions somewhat similar to those existing in works practice. During the year 1912, attention was directed to a study of the effect of treating various samples of hydrated oxide—pure oxide, bog ore, and artificial oxide—with excess of strong sulphuretted hydrogen in a closed vessel, and under conditions which permitted the rate of absorption and total absorption of gas to be studied, with a view to devising a method for the volumetric valuation of commercial oxides with respect to their sulphiding properties. In addition to the laboratory experiments, temperature readings were obtained at one English works and two Scottish works (by the courtesy of managers), with a view to extending our knowledge of the conditions which favour the "souring" of oxide. The results of these various investigations will now be considered.

LABORATORY INVESTIGATION.

Action of Sulphuretted Hydrogen on Hydrated Oxide of Iron and Valuation of Oxides by the Sulphuretted Hydrogen Burette.

The method consisted in treating a small weighed quantity of air-dried and moistened oxide (0·6 to 1 gramme oxide, containing 15 to 20 per cent. of moisture) with excess of sulphuretted hydrogen. The oxide was contained in a small glass cup floating on the surface of mercury in a laboratory vessel. The sulphuretted hydrogen was measured in a burette over mercury, on which it has no action at ordinary temperatures in the absence of oxygen. To eliminate air from the upper part of the laboratory vessel, the cup was made as small as possible, and the neck constricted somewhat to fit a corresponding constriction in the cylinder enclosing it; and the body of air was further reduced by causing the mercury to rise in the annulus between the cup and cylinder to a fixed mark on the neck of the latter. By this means the working volume was reduced to about 15 c.c. under a reduced pressure of 760 − 70 = 690 mm. It was displaced by carbon dioxide, or preferably hydrogen, before the sulphuretted hydrogen was admitted. By thus working with a constant volume of an inert gas in the laboratory vessel, the contraction that ensues during the sulphiding of the oxide is made an exact measure of the weight of sulphur absorbed, as temperature and pressure corrections are insignificant for 15 c.c. of gas in comparison with the large volume of sulphuretted hydrogen absorbed by the oxide (150 to 200 c.c.), and can easily be calculated and allowed for if desired.

The earlier series of experiments made during 1912 were all carried out with a modified form of Bunte burette; the later experiments were made with a form of apparatus substantially similar to that shown in the accompanying illustration, which embodies the improvements suggested by experience. In principle, the two forms of apparatus are the same; but the second form is easier to manipulate, and gives the more accurate results. It will be convenient to describe the burette and its method of working before proceeding to discuss the experimental results.

Sulphuretted Hydrogen Burette, and Hydrogen Filter.

Figs. 1 and 3 are drawn to a scale of not quite one-sixth full size; fig. 2 is nearly a full size sectional drawing.

The sulphuretted hydrogen burette consists essentially of the following parts: (1) Gas-measuring burette, water jacketed (capacity 250 c.c.); 250 c.c. to 240 c.c. narrow bore, 38 mm. long by 18·3 mm. internal diameter; 240 c.c. to 100 c.c. wide bore, 150 mm. long by 34·5 mm. internal diameter; 100 c.c. to the top, narrow bore, 400 mm. long by 18·3 mm. internal diameter.

The burette is provided above with a two-way gas-tap M (fig. 1), connected to the sulphuretted hydrogen generator through the ⊥-piece J, and to the air through the oxide of iron filter A above, and on the right to a hydrogen Kipp and a laboratory vessel D. Below, the burette is connected, through a ⊥-piece on the left with a mercury reservoir (internal diameter 58·5 mm., capacity 350 c.c.), and on the right with a levelling-tube of narrow bore (8 to 9 mm. diameter). The levelling tube is placed immediately on the right of the gas-burette, and with the vertical axes parallel. A screw clip is placed on the rubber connection O (fig. 1) to shut off the levelling-tube when the mercury reservoir is raised to its full height during charging or emptying the burette. Otherwise, mercury would flow out at the open end.

(2) *Levelling Slide.*—A short slip of wood carrying a horizontal arm extending behind the gas-burette and levelling-tube, and free to move in a vertical direction with slight friction to prevent slipping. The centre of the slip carries a small square of looking-glass ruled horizontally with a line at the centre. Two corresponding lines are ruled on the paper surface of the arm. The line behind the levelling-tube is adjusted by trial to be at a slightly lower level than that of the line behind the burette, to allow for capillarity. At atmospheric pressure, when the image of the eye is seen to be bisected by the line on the glass, the two lines on the arm should appear to be tangentially placed with respect to the surfaces of the mercury in the two tubes at all positions of the sliding arm.

(3) *Laboratory Vessel.*—A glass cylinder 170 mm. long by 36 mm. internal diameter (capacity about 170 c.c), sealed at its lower end in mercury contained in an outer glass cylinder 120 mm. long by 60 mm. diameter. The shape and dimensions of the laboratory vessel and oxide cup are shown in the sectional drawing D (fig. 2). Attention is directed to the four glass knobs sealed on to the shoulder of the cup. These serve as stops, holding the cup centrally in position when at the top of the cylinder and allowing mercury to rise freely in the annulus to a fixed mark (*h*). If the stops be omitted, gas is apt to be entrapped between the shoulder of the cup and the cylinder, and is difficult to displace. A side tube with stopcock B (fig. 1) is attached to the laboratory vessel at (*b*). This tube is useful for clearance purposes, and serves to

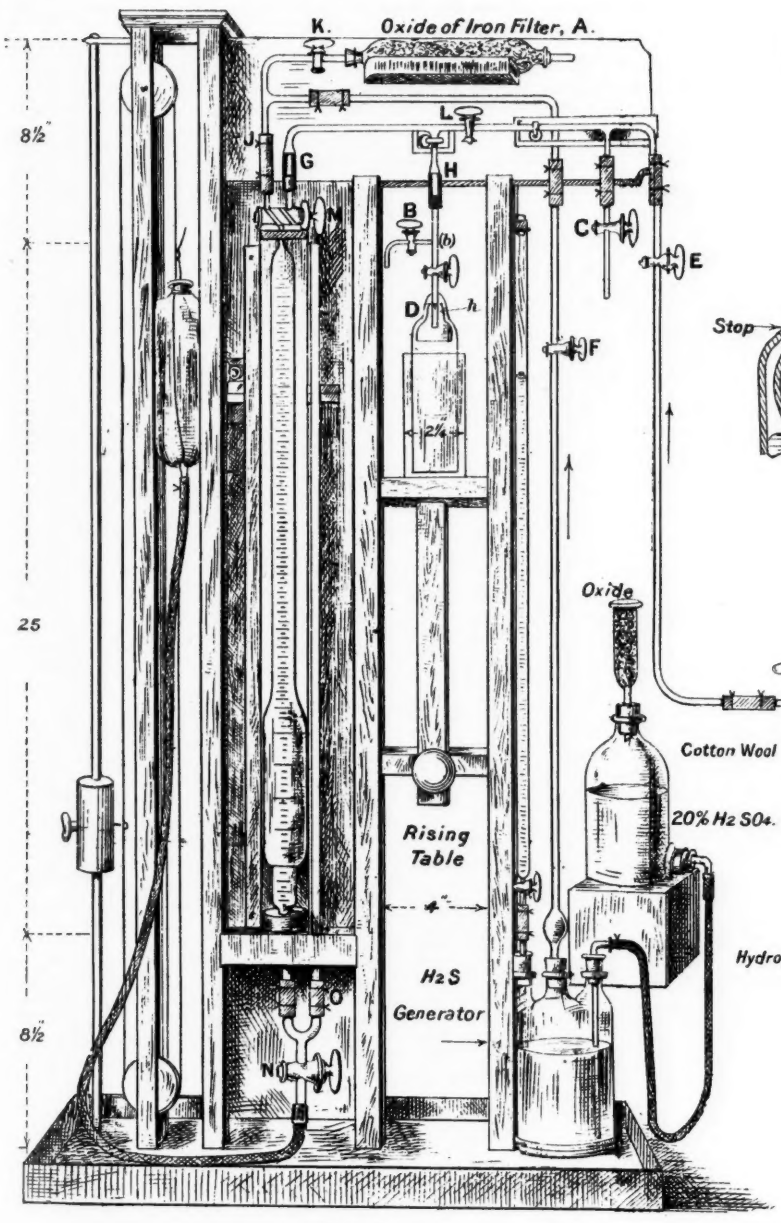


Fig. 1.

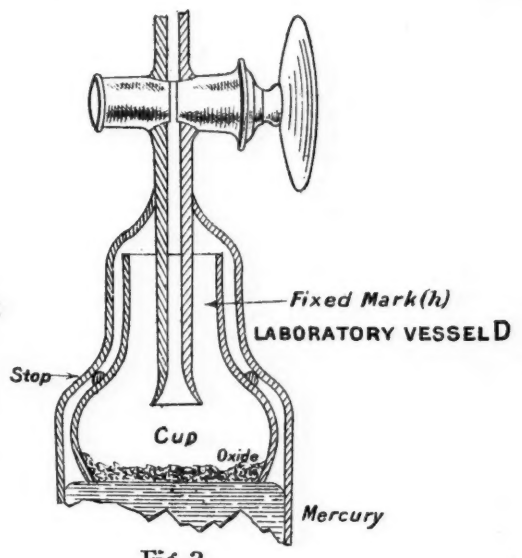


Fig. 2.

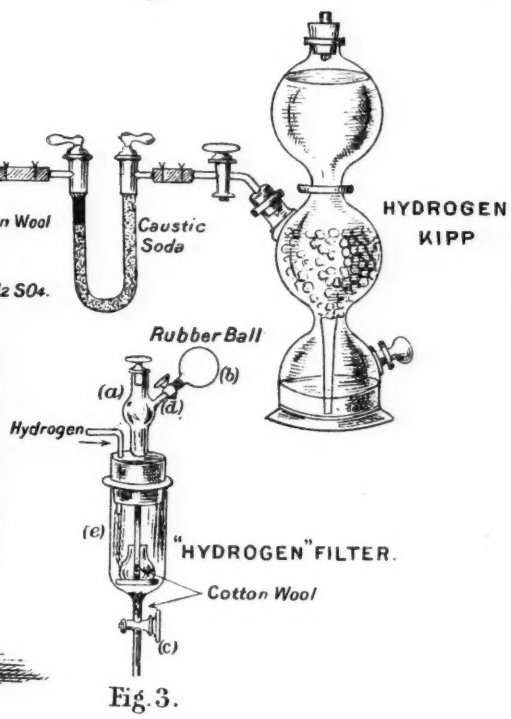


Fig. 3.

admit ether to the cup when the extraction of the sulphided material with carbon disulphide is desired.

Sulphuretted hydrogen is slowly absorbed by rubber tubing. This necessitates special "mercury" joints at G and H (fig. 1). A satisfactory joint is made by sealing on to the capillary tube a piece of glass about 35 mm. in length, and sufficiently wide to enclose the tube to which connection has to be made. The joint is made good by a rubber ring 10 mm. wide; the annulus above being filled with mercury (20 mm.), which protects the rubber from contact with the gas, and effectually excludes air.

(4) *Sulphuretted Hydrogen Generator.*—A three-necked Woulfe bottle (capacity about 600 c.c.) fitted with rubber corks. Connection on the right is made with a levelling bottle containing 20 to 30 per cent. sulphuric acid, and provided in the neck with a small oxide filter; on the left with a 50 c.c. burette holding strong ammonium sulphide solution. A capillary tube connects the Woulfe bottle centrally with the gas-burette through the stopcock F. The ammonium sulphide should be prepared from strong ammonia free from carbonate, and kept in a well-stoppered bottle under a layer of paraffin oil; and 10 c.c. to 15 c.c. of the solution should yield sufficient gas for an experiment—250 c.c.

(5) *Hydrogen Kipp* and stoppered U-tube filled with solid caustic soda to remove moisture and traces of carbon dioxide, and with a plug of cotton wool at the exit end.

Method of Operating the Burette.

In carrying out an experiment, it has to be remembered that sulphuretted hydrogen acts rapidly upon mercury if oxygen be present. Great care should be taken, therefore, that all the connections are tight. When emptying the burette of sulphuretted hydrogen after a sulphiding experiment, it is desirable to clear out the last traces of gas with hydrogen before admitting air to the burette. Omission of this precaution is apt to cause serious discoloration of the surface of the mercury. It is desirable also to work with a minimum of water in the burette. The hydrogen in the laboratory vessel will be in contact with moist oxide, and addition of water is unnecessary here. In the burette a small drop of water can be admitted by removing the stopcock M, if desired, to complete the saturation of the sulphuretted hydrogen evolved in the generator.

The following procedure was followed: Lower the rising table and insert the cup in laboratory vessel D (fig. 1). All stopcocks being shut, open B and D, and raise the table until the cylinder touches the bottom of the outer vessel. Close B, and suck up the mercury to fixed mark (*h*) by lowering the mercury reservoir and opening M; reject this air through oxide filter A; finally admit hydrogen to the laboratory vessel to atmospheric pressure—about 35 to 40 c.c. in all. Withdraw the mixed air and gas as before, and repeat the operation five times in all, leaving the mercury at fixed mark (*h*) and the hydrogen in the capillary connection G H at atmospheric pressure. The gas in D is then practically free from oxygen and at standard volume—*i.e.*, about 15 c.c. under reduced pressure.

All stopcocks being closed, prepare about 30 c.c. of sulphuretted hydrogen, pass it into the burette, and reject it through oxide filter A. Close K and prepare 250 c.c. of gas, transfer to the burette about 245 c.c., and bring this to atmospheric pressure by the aid of the sliding arm and levelling-tube.

The sulphiding operation is then carried out by opening the stopcock D and admitting sulphuretted hydrogen freely to the

laboratory vessel, pressure being maintained at atmospheric in the system by suitable regulation of the mercury reservoir. After the first few minutes have passed, and when the absorption of gas has lessened, the residual gas is brought back into the burette, and then returned to the laboratory vessel once or twice to ensure admixture of hydrogen and gas. The rising table is then lowered somewhat, and the oxide left in contact with about 100 c.c. of gas for one hour, with occasional adjustment of pressure. The residual gas is then brought back into the burette, and the volume rapidly read off under atmospheric pressure. The absorption is then allowed to continue as before.

The weight of oxide taken should be such as to result, if possible, in a total contraction of at least 150 to 160 c.c. The final readings are then made in the narrow part of the tube, and greater accuracy ensured. But this is not an essential point, as the burette is graduated throughout.

In the case of certain oxides—*e.g.*, those containing carbonates—carbon dioxide is liberated in greater or less amount. When this occurs, analysis of the residual gas left in the burette may become necessary. It can be effected in one of two ways:

(1) The whole of the residual gas can be discharged from the burette through C into the caustic soda solution, and the gas in D displaced by dilution with hydrogen repeated five times, as already explained, and the gas sent through the soda solution. The sulphide is then determined by N/10 iodine, and the volume of H_2S (0° C., 760 mm.) calculated. The volume of CO_2 is obtained by difference. It equals the volume of residual gas in the burette, less the volume of H_2S found as above. This method eliminates the volume of the laboratory vessel and contents from the calculation, but leads to slightly high results from the slow liberation of sulphuretted hydrogen dissolved in the moisture present in the sulphide; but this is small in amount.

(2) The residual gas left in the burette at the end of an experiment, together with that in the capillary connections, is discharged through B into the caustic soda solution. A little hydrogen is then passed into the burette, and discharged through B to clear out the last traces of gas. Knowing the volume of the capillary connections and of the gas space in D, the total amount of sulphuretted hydrogen left at the end of an experiment can be readily calculated from the iodine equivalent of the sulphide found. This method is open to the objection that the calculations are more troublesome, and involve an exact knowledge of the volume occupied by the sulphided material, which is not a constant factor.

The first method seems preferable, and is sufficiently exact for a technical method of analysis such as this.

Determination of Approximate Volume Contents of Gas Space D for Temperature and Pressure Connections.

The empty cup is placed in D, and the mercury sucked up to mark (*h*). The air is then displaced by hydrogen, as already explained, and the hydrogen by moist sulphuretted hydrogen in the same way. Finally, connections and gas burette are cleared of sulphuretted hydrogen by admitting a little hydrogen, and discharging it through A. Distilled water is then sucked into B, so as to fill the capillary tube as far as connection with tube (*b*). About 40 c.c. of hydrogen are now passed into the gas burette, and the volume measured moist at atmospheric pressure.

About 5 c.c. of normal caustic soda are then allowed to enter at B, and partially fill the cup D. As soon as absorption is finished, the level of the mercury in D is brought to (*h*), and the volume of gas in the burette noted at atmospheric pressure; the gas is then returned to D, and again brought back into the burette and measured. If no change of volume is noted, the absorption is taken as complete. Hydrogen is then admitted to D, and the cup removed and its contents diluted and titrated with N/10 iodine in the usual way. An example will render the method of calculation clear—

Before absorption—		
Temperature of gas in laboratory vessel D, 8·4° C., 689·8 mm.		
Volume of hydrogen in burette, 7·3° C., 761·8 mm.		
After absorption—		36·8 c.c.
Volume of hydrogen in burette		26·8 ,,
Contraction		10·0 c.c.
Volume of empty cup to neck . .	12·3 c.c.	
Volume of water required to fill cup to neck with soda present .	6·9 ,,	
		5·4 ,, (volume of soda admitted).
Total H_2S absorbed . . .		15·4 c.c.
N/10 iodine reduced by sulphide.	12·16 c.c.	
Whence, vol. H_2S (0° C., 760° mm.) = 13·6 c.c.		
This 13·6 c.c. at 8·4° C. and 689·8 mm moist would occupy		15·6 c.c. (as above).
The gas space in D is therefore		15·5 c.c. (approx. with the cup empty).
Deduct volume of oxide . .		·5 c.c.
Net gas space during a sulphiding experiment		15·0 c.c.

The hydrogen filter serves to carry out extractions of sulphided material with carbon disulphide or water in absence of air. It consists of the following parts: A glass cylinder (*e*) 100 mm. long by 44 mm. wide (capacity about 140 c.c.), fitted with stopcock (*c*) below, and closed by a rubber stopper carrying a hydrogen inlet tube on the left, and a stoppered glass tube (*a*) centrally with side tube (*d*) and stopcock. A small rubber ball (*b*) is attached to (*d*) on occasions when gentle pressure has to be applied. The stem of (*a*) is narrowed below, and slightly constricted at a point about 20 mm. from the bottom. Cotton wool is inserted in the open end of the tube to serve as a filter.

When operating the filter, anhydrous ether (sp. gr. ·717) is admitted to the cup in the laboratory vessel D, through stopcock B, at the end of an experiment, and after the residual sulphuretted hydrogen has been removed by hydrogen. The ether serves to exclude air from contact with the moist sulphide, and dilutes the water present in preparation for its removal in the hydrogen filter as a necessary preliminary to extraction of the sulphide with carbon disulphide. After removal of the cup to the filter (*e*), connection is made with C (fig. 1), and the air displaced by dry hydrogen; stopcock (*c*) being open on the filter to allow the gas to escape below; (*c*) is now closed, and the ether allowed to rise in (*a*), and is finally poured off through (*d*) by rotating (*e*) on the clamp that holds it. Fresh ether is then poured into (*a*), the stopper replaced, the rubber ball adjusted on (*d*), and gentle pressure applied to drive the ether down into the cup, (*c*) being opened momentarily to relieve the pressure in (*e*). The ether is then removed as before, and carbon disulphide admitted and the extraction repeated. Care must be taken that the carbon disulphide wets the sulphide. If contact is imperfect, a little ether should be added to the disulphide first admitted. Extraction is facilitated if a gentle rotatory movement be imparted to the cup. The extracting liquid should be entirely driven up into the tube (*a*), so as to leave the sulphide dry before (*e*) is rotated on the clamp and the liquid poured off through (*d*); but the gas should not be allowed to pass through the cotton wool. After extraction with carbon disulphide is completed, ether is again admitted and removed as before. Treatment with hot water then follows; gentle suction being applied at (*d*), if necessary. The residue obtained on evaporation of the ether and disulphide is oxidized, and the sulphur determined as barium sulphate in the usual way.

About 1 gramme of an oxide (containing 50 per cent. $Fe_2O_3.H_2O$) is a convenient amount to take for a sulphiding experiment.

EXPERIMENTAL RESULTS.

The physical properties of bog ore and other oxides of iron used for purification purposes were fully discussed in the annual report for 1911, and the behaviour on sulphiding of a sample of natural oxide from the New Southgate Gas-Works was studied in detail both in the laboratory and the works. During these experiments, the want of a satisfactory method of determining the exact absorptive power of an oxide for sulphuretted hydrogen was seriously felt. The gravimetric method described by Lunge and Keane in "Technical Methods of Chemical Analysis," Vol. II., Part ii., p. 722, has obvious defects. The procedure is given by the authors as follows:

A portion of the sample which has passed through the ten-mesh sieve is placed in a weighed U-tube, which is again weighed to ascertain the weight of oxide taken. This is connected with a second U-tube containing calcium chloride, and the two tubes weighed together. A slow current of sulphuretted hydrogen from a Kipp or similar apparatus, previously dried with calcium chloride, is then passed through the U-tubes till these undergo no further increase of weight. Dry air is then drawn through the tubes to replace the sulphuretted hydrogen, and the tubes again weighed. The increase of weight gives the amount of sulphuretted hydrogen taken up by the oxide. The percentage absorbed is preferably calculated on the dried oxide. It gives an indication of the comparative value of the sample for purification purposes; a convenient method being to compare the figure thus obtained, in all cases, with that found by the same treatment with a known and tried sample of good material.

Such a method as this has the advantage of dealing with a large weight of material. But air is not effectually excluded; and no account is taken of carbon dioxide, which is freely liberated from some oxides and lost in the residual gases. Moreover, the method is not very suitable for determining the maximum efficiency of oxides which absorb sulphuretted hydrogen over a period of six or seven days. In purifiers which remain undisturbed for many days, the bottom layers of oxide are in contact with gas for prolonged periods; and a measure of the maximum efficiency attained on exhaustive exposure to the gas is a desideratum. A gravimetric method with apparatus involving many parts, and necessitating disconnection for weighing from time to time, is open to criticism. The use of dry air at the end of an experiment to displace residual gases is inadmissible in exact analysis. A volumetric method has advantages; and it was for the purpose of devising such a method that much of the present work was undertaken.

It will be convenient to consider the results of the sulphiding experiments on oxide of iron in three groups in the following order and regardless of chronological sequence:

1.—Pure hydrated oxide of iron ($Fe_2O_3.H_2O$).
2.—Pure hydrated oxide mixed with sodium or calcium carbonate.
3.—Natural and artificial oxides.

(1) *Experiments on Pure Hydrated Oxide.*—The oxide was prepared by precipitating a warm solution of ferric chloride with ammonia, and thoroughly washing the precipitate with hot water to remove chloride. The wet mass was dried in bulk on a water bath in a porcelain dish, with occasional stirring, until granular. It was then ground to a somewhat fine powder and kept in a tightly stoppered bottle.

In its physical properties, the oxide thus prepared resembled native oxide, but was redder in colour. Exposed to the damp air

of the laboratory, it rapidly gained in weight—7 per cent. in six days. As prepared, the oxide corresponded in composition to $Fe_2O_3.3H_2O$; dried at 100° C., to $Fe_2O_3.H_2O$; and after ignition, to Fe_2O_3. Thus—

	Loss of Water per 100 Parts of Air-Dried Oxide.	
	Found.	Calculated.
At 100° C.	16·8 ..	16·8
At full red heat	25·1 ..	25·2

The oxide dried at 100° C. was very hygroscopic. The ignited oxide showed no tendency to combine with water, even when left in contact with it for 24 hours. Redried at 100° C., the weight was the same. The behaviour of this hydrated oxide towards sulphuretted hydrogen closely resembles that of natural oxide.

Sulphiding Experiments.—The sulphiding experiments were all made under the same conditions. The same weight of oxide was taken (0·6 gramme, air dried; 0·5 gramme $Fe_2O_3.H_2O$) and of sand (0·5 gramme pure white sand), with sufficient water to bring the total moisture content of the mixture to about 14 per cent. Water is formed during the sulphiding operation (100 c.c. of H_2S equal 0·107 gramme water), and the total moisture present in the sulphided material was therefore about 0·35 gramme. Sulphuretted hydrogen is soluble to some extent in water. A correction factor was obtained by means of a blank experiment, in which 2 grammes of sand were moistened with 0·44 gramme of water and exposed to contact with sulphuretted hydrogen under conditions approximating to those that existed at the end of an absorption—viz., residual gas containing 45 volumes of H_2S and 15 volumes of hydrogen; and the amount of contraction was then noted at various temperatures.

The results of two sulphiding experiments are given in the following table. The average volume of sulphuretted hydrogen absorbed in one day was 374·6 c.c., and in two days 376·3 c.c. per gramme of oxide dried at 100° C. [air temperature 10° C.], and is approximately that which is required by theory (376·1 c.c.) for the reaction—

$$Fe_2O_3.H_2O + 3H_2S = Fe_2S_3 + 4H_2O.$$

Further slight absorption occurs if the period of treatment is extended; but the volume differences are small, and approach the limits of experimental error. Possibly a small amount of hydrosulphide is formed.

It would appear, therefore, that a sample of pure hydrated oxide is practically sulphided on exposure to excess of sulphuretted hydrogen for two days, and that 1 gramme of the oxide dried at 100° C. is the equivalent of 376 c.c. of H_2S at 0° C. and 760 mm. on a two days' test.

Period.	H_2S Absorbed at 0° C. 760 mm. by One Gramme of $Fe_2O_3.H_2O$.			
	A.	B.	Mean Volume Absorbed.	
	c.c.	c.c.	c.c.	Per Cent. of 376.
1 hour	302·6	312·4	307·5	81·8
2 hours	334·0	343·0	338·5	90·2
3 ,,	349·0	357·4	353·2	94·0
4 ,,	357·0	364·6	360·8	95·9
1 day	374 8	374·4	374·6	99·7
2 days	376·2	376·4	376·3	100·1
3 ,,	377·2	377·0	377·1	100·3
4 ,,	—	377·4	377·4	100·4
5 ,,	378·0	—	378·0	100·5

Approximate analysis of sulphided product A:—
0·6 gramme moist oxide = 0·5 gramme $Fe_2O_3.H_2O$.
H_2S absorbed, 189 c.c. = 0·2710 gramme sulphur.

—	H_2S as Sulphur Recovered (Grammes).					
	Free.	Thiosulphate.	Sulphite.	Sulphate.	Disulphide and other Forms.	Total.
In the sulphide	·0303	Nil	Nil	·0005	·0120	..
After oxidation (two days)	·2285	..	..	·0020		
Further oxidation (one day)	Trace	..	..			
Total	·2588	Nil	Nil	·0025	·0120	·2733
Per cent. of total	94·7	..	..	·9	4·4	100

The sulphided material oxidized fairly rapidly. It was slightly acid to litmus, and contained a trace of ferrous sulphate.

(2) *Pure Hydrated Oxide Mixed with Sodium or Calcium Carbonate.*—In this series of experiments 0·6 gramme of pure oxide was mixed with 0·5 gramme of pure sand together with about 0·20 gramme of the carbonate and 0·15 gramme of water. The materials were intimately mixed in the glass cup and sulphided as before. After absorption ceased, the residual gases were passed into caustic soda solution, the sulphide titrated with N/10 iodine, and the carbon dioxide determined by difference, following method 2.

Before setting out the results of typical experiments, it is necessary to consider the action of sulphuretted hydrogen on sodium and calcium carbonates acting alone.

Action of Sulphuretted Hydrogen on Sodium Carbonate.—Results point to the formation of hydrosulphide and bicarbonate. Thus: 0·1865 gramme Na_2CO_3, 0·5 gramme sand, 0·14 gramme water.

Period.	Volume of H_2S Absorbed at 0° C., 760 mm. [Air Temperature 9° C.]	
	A.	B.
	c.c.	c.c.
10 minutes	21·6	19·6
30 ,,	22·1	..
1 hour	22·8	20 2
2 hours	23·1	..
19 ,,	..	28·1

The residual gases contained no carbon dioxide. The sulphided product was unstable in pure hydrogen, slowly decomposing with evolution of sulphuretted hydrogen. Possibly, reaction proceeds to partial completion, according to the equation—

$$Na_2CO_3 + H_2S = NaHS + NaHCO_3.$$

Complete interaction would correspond to an absorption of 39·4 c.c. H_2S.
Contraction found (19 hours) 28·1 ,,

Action of Sulphuretted Hydrogen on Calcium Carbonate.—2 grammes of pure precipitated calcium carbonate and 0·07 gramme of water. Contraction in 21 hours, 0·3 c.c., at 9° C. The residual gas contained no CO_2. Sulphuretted hydrogen would appear from this to be without action on moist calcium carbonate.

(*a*) *Pure Oxide of Iron and Sodium Carbonate.*—The materials were mixed, as before, with addition of pure sand and water: 0·6 gramme of moist oxide (= 0·5 gramme $Fe_2O_3.H_2O$), 0·5 gramme sand, 0·191 gramme Na_2CO_3, and 0·11 gramme water.

The earlier apparatus (unjacketed burette) was used in this experiment. The results, therefore, are approximate only, and the results of analysis of the sulphided product, similarly, have qualitative rather than quantitative significance. Air temperature during sulphiding, 13° C.

Total contraction measured in the burette . . . . 184·0 c.c.
Add volume of CO_2 liberated . . . . 37·4
Total H_2S absorbed . . . . 221·4
= 0·317 gramme sulphur.

In this experiment, the cup, after sulphiding, was filled with strong alcohol before removal from the laboratory vessel to the hydrogen filter. The alcohol was then removed, and the sulphide extracted with hot boiled water, and the extract exactly neutralized with N/2 HCl. On oxidation with N/10 iodine, the solution became acid—showing that sulphite was present. The sulphide was then oxidized by exposure to warm air as usual dried at 70° to 80° C., and the free sulphur extracted with carbon disulphide, and the oxide subsequently digested with hot water to extract alkali and soluble sulphur compounds. The process of oxidation and extraction was then repeated twice. The results are as follows [Total sulphur as H_2S absorbed, 0·317 gramme]:

—	Alkali calculated as Na_2CO_3	H_2S as Sulphur Recovered, in Grammes.					
		Free.	Thiosulphate.	Sulphite	Sulphate.	Disulphide and Other Forms.	Total.
In the sulphide	·010	..	Nil	·0003	Nil	·006	..
On oxidation (6 days)	·094	·2519	·0357	Nil	,,		
Further oxidation (1 day)	Traces	·0075	·0024	,,	Traces		
,, ,, ,,	Nil	·0006	·0004	,,	,,		
Total	·104	·2600	·0385	·0003	Not determined.	·006	·3048
Per cent. of total sulphur (0·317 gramme) taken.	..	82·0	12·2	·1	..	1·9	..

Total weight of sodium carbonate taken = 0·191 gramme.
In the sulphide unacted on . . . 0·010
Reacting 0·181
Alkali recovered on oxidation free . 0·094
,, ,, as thiosulphate . . 0·063
Recovered 0·157
Sulphate and other forms by difference . . . 0·024
Sodium carbonate (0·181) reacting is equivalent to . . . . . 38·2 c.c. CO_2
In the residual gases found 37·4 ,,

(*b*) *Pure Oxide of Iron and Calcium Carbonate.*—Taken for sulphiding 0·60 gramme oxide (= 0·5 gramme $Fe_2O_3.H_2O$), 0·5 gramme sand, 0·2045 gramme calcium carbonate, and 0·065 gramme water. The old apparatus was used. (Air temperature, 9° C.)

Total contraction measured in the burette . 183·5 c.c.
Add volume of CO_2 liberated . . 20·5 ,,
Total H_2S absorbed . . . 204·0
= 0·292 gramme sulphur.

For total decomposition, 0·2045 gramme $CaCO_3$ would yield 45·8 c.c. CO_2.

The following is an analysis of sulphide:

—	Reaction to Litmus.	H_2S as Sulphur Recovered, in Grammes. Free.	Thiosulphate.	Sulphite.	Sulphate.	Disulphide and other Forms.	Total.
In the sulphide .	Neutral	..	Nil	Nil	Traces		
On oxidation (1 day) . .	Slightly alkaline.	·2608	·0090	,,	,,		
Further oxidation (2 days)	,,	·0110	·0013	,,	,,	·0063	..	..
Further oxidation (1 day)	,,	·0010	·0013	,,	,,		
Further oxidation (1 day)	,,	·0010	·0003	,,	,,		
	..	·2738	·0119	Nil	·0063	..	·2920
Per cent. of total sulphur (0·292) taken	..	93 8	4·1	Nil	2·1	..	100

Exact analysis is difficult when dealing with such small weights of material; but the results afford undoubted evidence that both sodium and calcium carbonate interact with sulphuretted hydrogen in presence of hydrated oxide of iron and moisture. The volume of H_2S absorbed is in excess of that absorbed by pure oxide of iron —221·4 c.c. with Na_2CO_3 present; 204·0 c.c. with $CaCO_3$; 189 c.c. with oxide of iron alone (0·6 gramme moist). Further, carbon dioxide is liberated in amount equivalent to the alkali decomposed, and on oxidation free alkali is formed, together with thiosulphate, sulphate, and free sulphur; and the rate of oxidation of the sulphided product is distinctly slower than with a pure product. These results are consistent with the formation of a double sulphide of iron with soda or lime—say, $Fe_2S_3.Na_2S$ or $FeS.Na_2S$. Such a body on oxidation might be expected to yield free sulphur, thiosulphate, and caustic alkali. Thus—

$$2\ Fe_2S_3.Na_2S + 10O = 2\ Fe_2O_3 + Na_2O + 6\ S + Na_2S_2O_3, \text{ or}$$
$$2\ FeS.Na_2S + 7O = Fe_2O_3 + Na_2O + 2\ S + Na_2S_2O_3.$$

The sulphate present may be a secondary product. Such a reaction would yield half the alkali in the free state; and this was found to be the case with sodium carbonate—viz., 0·094 soda recovered is approximately half 0·181 reacting.

If a double sulphide is formed, the oxide of iron in the mixture should absorb its full equivalent of sulphuretted hydrogen, while the alkaline carbonate would absorb sulphuretted hydrogen and give off an equivalent volume of carbon dioxide. The total contraction should be the same as with pure oxide, if the reaction proceeds to completion, and oxysulphides or other oxidized products are not formed. It was found to be rather less. Thus:

With sodium carbonate present	184·0 c.c.
,, calcium carbonate present	183·5 ,,
,, pure oxide	189·0 ,,

Absorptive Power of Hydrated Oxides of Iron for Sulphuretted Hydrogen at Air Temperature.

—	Natural Oxides. Works A. Bog Ore.	Works D. Irish Oxide.	Works A'. Dutch Oxide.	Works B'. Irish Oxide.	Works D'. Irish. Expt. 1.	Works D'. Irish. Expt. 2.	Works G'. Bog Ore.	Artificial Oxides. Works A'. Material X.	Works B'. Material Y. Expt. 1.	Works B'. Material Y. Expt. 2.	Pure Oxide. $Fe_2O_3.H_2O$.	Partially Spent Oxides. Works B. Bog Ore.	Works D'. Irish + Artificial.
Expt. No.	**I.**	**II.**	**III.**	**IV.**	**V.**	**VI.**	**VII.**	**VIII.**	**IX.**	**X.**	**XI.**	**XII.**	**XIII.**
Oxide per 100 parts, dried 100° C.—													
CO_2	1·9	2·7	1·3	2·0	..	..	2·1	3·3	5·2	5·0	Nil.	..	Nil.
$Fe_2O_3H_2O$	59·2	51·8	44·8	44·8	61·2	61·2	51·3	59·1	52·6	52·6	100·0	..	10·9
Oxide per 100 parts, air dried (two to three days)—Moisture, loss at 100° C.	11·0	26·9	23·6	11·0	9·7	9·7	19·2	13·0	14·7	14·7	16·8	3·4	2·1
Inert gas used to displace air . .	Hydrogen.	Hydrogen.	Carbon dioxide.	Hydrogen.	Carbon dioxide.	Carbon dioxide.	Hydrogen.	Hydrogen.	Hydrogen.	Hydrogen.	Hydrogen.	Carbon dioxide.	Hydrogen.
Material sulphided contains moisture—													
Per cent.	20·4	26·9	23·6	22·8	18·8	21·5	19·2	21·3	20·3	20·3	14·2	23·0	22·4
H_2S absorbed per gram of oxide dried at 100° C.													
Contraction—													
1 hour . . . . c.c., 0° C.	191·4	166·1	152·5	127·3	..	141·6	140·2	154·8	139·0	139·0	307·5	..	16·9
2 hours . . . . ,,	196·3	172·4	156·6	133·2	154·4	155·3	147·7	156·6	141·0	141·2	338·5	..	19·9
3 ,, ... ,,	198·9	175·1	158·8	135·9	160·9	160·2	151·1	157·3	143·0	142·0	353·2	..	21·6
4 ,, ... ,,	201·0	177·0	160·3	137·4	165·7	165·7	153·4	..	143·5	142·9	360·8	90·1	..
1 day . . . . . ,,	212·3	185·6	168·3	146·2	189·1	188·5	165·9	161·8	146·4	145·2	374·6	111·9	29·5
2 days . . . . . ,,	216·9	189·0	170·5	149·6	197·3	196·5	169·0	163·7	147·5	146·5	376·3	118·3	32·9
3 ,, ... ,,	219·1	190·5	171·5	151·0	200·8	200·1	171·4	..	..	..	377·1	122·1	33·5
4 ,, ... ,,	220·7	191·8	..	151·8	..	..	..	165·9	..	..	377·4	124·7	..
5 ,, ... ,,	223·7	..	171·1	..	205·5	204·5	173·9	167·5	..	..	378·0	128·4	35·3
6 ,, ... ,,	..	193·4	..	152·8	207·3	206·3	..	..	..	..	..	129·2	36·1
7 ,, ... ,,	224·4	193·9	..	153·2	208·6	207·3	175·5 (8 days)	..	..	..	..	..	36·4
Total contraction . . .	224·4	193·9	171·1	153·2	208·6	207·3	175·5	167·5	147·5	146·5	378·0	129·2	36·4
CO_2 evolved . . . . c.c., 0° C.	2·9	4·0	2·0	..	..	..	4·9	9·8	..	17·8	..	..	..
Total H_2S absorbed ,,	227·3	197·9	173·1	..	..	..	180·4	177·3	..	164·3	378·0	..	36·4
H_2S equivalent to $Fe_2O_3H_2O$ taken at c.c., 0° C.	222·7	194·8	168·7	168·7	230·2	230·2	193·0	222·3	198·0	198·0	376·0	..	46·0
"Efficiency" of oxide found—													
Four hours' test $= \frac{100}{361} \times$ contraction	55·7	49·0	44·4	38·1	45·9	45·9	42·5	..	39·8	39·6	100·0	24·9	..
One day's test $= \frac{100}{375} \times$,,	56·7	49·5	44·9	39·0	50·5	50·3	45·2	43·2	39·1	38·8	100·0	29·9	7·9
Two days' test $= \frac{100}{376} \times$,,	57·7	50·3	45·4	39·8	52·4	52·3	45·0	43·5	39·2	39·0	100·0	31·5	8·7
Five days' test $= \frac{100}{378} \times$,,	59·2	51·0	45·3	40·3	54·4	54·1	46·0	44·3	..	..	100·0	34·0	9·3
Seven days' test $= \frac{100}{379} \times$,,	59·2	51·2	..	40·4	55·1	54·7	46·2 (8 days)	..	..	..	100·0	34·2 (6 days)	9·6
Ditto corrected for CO_2	60·0	52·2	45·8	..	..	..	47·5	46·9	..	43·7	100·0	..	..
Theoretical "efficiency" calculated from $Fe_2O_3H_2O$ content of oxide	59·2	51·8	44·8	44·8	61·2	61·2	51·3	59·1	52·6	52·6	100·0	..	10·9

(3) *Natural and Artificial Oxides.*—Natural oxides absorb sulphuretted hydrogen with extreme rapidity, but complete saturation is only effected after exposure to the gas for several days. Calcium carbonate is usually present in small amount in such ores, and on sulphiding partial decomposition occurs with evolution of carbon dioxide. The amount of this gas can readily be determined and allowed for, if desired, by analysis of the residual gases left after sulphiding in the burette. In the case of certain artificial oxides where alkaline carbonate is present, the evolution of carbon dioxide is very marked—indeed, the amount is such as to falsify the results unless allowance is made for it. The point has already been referred to.

In cases where carbonate is present, analysis of the sulphided product after oxidation yields results similar to those already recorded for mixtures of sodium and calcium carbonate with pure oxide. The results of a number of analyses of both natural and

artificial oxides are brought together in Table A. The descriptive lettering at heads of columns—"Works A," "Works D," &c.—is the same as that adopted in the tables given in the report for 1911, and relates to the same works.* For convenience of reference, the experiments are numbered I. to XIII.

The following conclusions are drawn from these results with respect to the value of the volumetric method of determining the absorptive power of a given oxide for sulphuretted hydrogen.

(I.) *Rate of Sulphiding.*—The rate in the case of natural and spent oxides is rather less than that with pure oxide; but the rates are sufficiently near to enable an approximate measure of the sulphiding value of an oxide to be obtained by a four-hours' test. The percentage of total H_2S absorbed in five days was:

Period.	Works A.	Pure Oxide.
Four hours	90	95·5
One day	95	99·2
Two days	97	99·5
Five days	100	100·0
Total absorbed	223·7 c.c.	378·0 c.c.

(II.) "*Efficiency*" *of an Oxide.*—We may define the "efficiency" of an oxide as the maximum volume of H_2S, measured at 0° C., 760 mm., that a given weight of oxide (dried at 100° C.) is capable of absorbing, calculated per 100 volumes of H_2S absorbed by an equal weight of ferric hydrate ($Fe_2O_3.H_2O$) under similar conditions. The results presented in Table A show that the "efficiency" of a given oxide can be accurately determined by a five-days' test, and approximately by a shorter test. Thus (experiment I.):

One day's test	56·7
Two days' test	57·7
Five days' test	59·2
Seven days' test	59·2

On this basis, the theoretical maximum "efficiency" of an oxide expresses the amount of hydrated oxide of iron ($Fe_2O_3.H_2O$) present per 100 parts of oxide dried at 100° C. Thus (experiment I.):

$$\text{Maximum "efficiency" calculated } \left(= 100 \times \frac{59{\cdot}2}{100} \right) = 59{\cdot}2$$

$$\text{Percentage of } Fe_2O_3.H_2O \text{ in oxide} = 59{\cdot}2$$

The actual "efficiency" as found by experiment is, in general, much below the theoretical maximum deduced from the percentage of iron present, indicating the presence of ineffective compounds of iron.

(III.) *Effect of Carbonate.*—If present, sodium or calcium carbonate tends to re-act, forming double sulphides with evolution of CO_2. In the case of natural oxides, the amount of CO_2 is small and can be neglected in an approximate test. In the case of artificial oxides where carbonates are present, the amount is large and must be allowed for.

WORKS TESTS.

During the past year, the courtesy of managers enabled me to continue the series of temperature experiments at oxide of iron purifiers in sulphate of ammonia works begun in 1911, and recorded in the report for that year. The previous tests were taken at two works where "souring" has rarely been noticed; at both, the oxide was revivified *in situ* by air injected with the foul gases. The highest temperature recorded at one of these works was 98° C. (208° Fahr.) and at the other 55° C. (131° Fahr.). At the former works, conditions were very unfavourable for efficient purification, and on occasions traces of sulphuretted hydrogen escaped unabsorbed. At the latter works, conditions were normal. A temperature of 55° C. is therefore consistent with efficient working. It is interesting to note that 55° to 60° C. was also the temperature at which the oxide in the laboratory tube experiments showed maximum efficiency in respect of yield of free sulphur and absence of disulphide (FeS_2), both in the presence and absence of air.

Experiments during the year 1912 were made at three other works. At one of these works (Reading), "souring" trouble is never experienced; at the other two (Motherwell and Hamilton), "souring" has been more or less chronic. The results are of negative value only. In no case did the temperature of the oxide exceed 55° C., and no fact was observed which assists in throwing any light on the cause of "souring."

Attention was drawn in last year's report to Gedel's conclusion with respect to the specific effect induced by the presence of ammonia in the reacting gases. Alkaline conditions are held by Gedel to be favourable to the formation of the desired product, Fe_2S_3; acid conditions, to the formation of FeS_2. It is possible the presence or absence of ammonia in the saturator gases entering sulphate of ammonia purifiers may have an important bearing on the question of "souring." Moreover, in Scotland, where "souring" troubles are frequently met with, the acid used in the saturators is not usually dearsenicated, as it is in England so frequently. It is hoped that during the present year opportunity may be found to investigate the character of the saturator gases at one or two typical works, and temperature records will also be made during the revivification of oxide outside the purifier if opportunity offers.

Temperature of Oxide in the Sulphate of Ammonia Works Purifier at the Reading Gas-Works.

I am indebted to Mr. Douglas H. Helps, Assoc.M.Inst.C.E., for a very valuable and extended series of temperature records taken at Reading. There are at these works two purifiers placed side by side, with a dividing wall, and under one roof. One of the purifiers was used exclusively for the tests, and was charged afresh with a mixture of natural oxide and partially spent oxide from the gas-works. The latter material was in part taken from the water-gas plant, and contained much oily matter. The presence of oil rendered analysis of the oxide a matter of great difficulty, and no satisfactory determination of free sulphur was possible. Temperature records were made over a total period of 116 days, as follows: Period 1, purifier working 19 days, resting 52 days; period 2, purifier working 19 days, resting 26 days.

Two sets of three thermometers were inserted—one near the centre of the heap and the other at a distance of 3 ft. 6 in. from the side. In each set, one thermometer was placed with its bulb resting on the bottom grid, one 6 inches up, a third on the top grid. During each working period, temperature readings were taken every three hours on each day. During periods of rest, the number of readings was reduced to three, and finally to two per day. Both sets of thermometers gave somewhat similar readings. It is sufficient here to consider only the central group, and to present average readings—variations of temperature from hour to hour being very small.

The area of the working purifier was 20 ft. by 22 ft. = 440 square feet, with a depth of oxide on each grid of 2 ft. 3 in.—a total depth of 4 ft. 6 in. The total volume of oxide was therefore 1980 cubic feet, equal to 73·5 cubic yards, and weighed about 49 tons. The oxide was undisturbed throughout the whole period of the tests. The gas liquor used in the tests was sampled from day to day by a stoppered bottle, and an average sample taken for analysis at the end of each working period.

Period 1.—Purifier Working 19 Days, Resting 52 Days.

Average sample of gas liquor used contained per 100 parts—

Total NH_3	2·520 = 9·79 parts of $(NH_4)_2SO_4$.
CO_2	2·396.
H_2S	0·256.
HCy	Nil.

Whence the saturator gases contain per 100 vols.: CO_2, 87·8; H_2S, 12·2.

The total amount of liquor distilled during the 19 days was 120,105 gallons, equal to 263 gallons per hour, or 258 lbs. of sulphate of ammonia; the volume of CO_2 evolved per hour (by calculation) was 514 cubic feet; and the volume of H_2S evolved per hour (by calculation), 71 cubic feet. Whence the "rate of fouling," cubic feet H_2S per cubic yard of oxide per hour, was $71 \div 73{\cdot}5 = 0{\cdot}97$.

As sampled, the oxide contained 15·6 per cent. of moisture (loss at 100° C.); after drying by exposure to air for two days, 3·4 per cent. The maximum absorptive power for the H_2S (see Experiment XII.) was:

	Dried Oxide.	Moist Oxide (15·6 per Cent.).
Six-days' test	34·2	= 28·8
Pure $Fe_2O_3.H_2O$	100·0	..

The results of the temperature observations are given in Tables A and B. The maximum temperatures attained at each level are in italic type. The marked rise of temperature (Table B) which occurred on shutting-off the gas is attributed to the presence of adventitious air.

Period 2.—Purifier Working 19 Days, Resting 26 Days.

Average sample of gas liquor used contained per 100 parts—

Total NH_3	2·614 = 10·14 parts of $(NH_4)_2SO_4$.
CO_2	2·365
H_2S	0·245
HCy	Nil

Whence the saturator gases contain per 100 vols.: CO_2, 88·2; H_2S, 11·8.

The total amount of liquor distilled during the 19 days was 117,575 gallons, equal to 258 gallons per hour, or 262 lbs. of sulphate of ammonia per hour; the volume of CO_2 evolved per hour (by calculation) was 497 cubic feet; the volume of H_2S evolved per hour (by calculation), 66·5 cubic feet. Whence the "rate of fouling," cubic feet H_2S per cubic yard of oxide, per hour was $66{\cdot}5 \div 73{\cdot}5 = 0{\cdot}91$. The results are recorded in Tables C and D; and they are in agreement with those recorded in Tables A and B for Period 1.

Motherwell Gas-Works.

I am indebted to Mr. A. Mackay, the Engineer and Manager of these works, for the temperature records presented in Table E. "Souring" was a chronic source of trouble in the past when air was injected with the foul gases; but it has been less marked since the air supply has been discontinued and the foul gases submitted to increased cooling. During the test, the purifier was at work for about 10 hours each day, and rested for 14 hours. The oxide used for the tests was virgin bog ore. It was delivered wet (38·3 per cent. moisture), there was no opportunity of drying it, and during the test the weather was very bad. The conditions of the test were therefore exceptional, and the results afford no criterion as to the temperature reached by the oxide during periods of normal working.

The purifier is open to the air. It is 12 ft. 6 in. square inside, with 2 feet of oxide on the grid, having an area of 156·25 square feet, and holding 312·5 cubic feet, equal to 11·6 cubic yards—the approximate weight of oxide being 3 tons 10 cwt.

* See "Journal," Vol. CXIX., p. 330.

TABLE A.—*Temperature of Oxide at Centre of Purifier.*
[Period 1.]

Date.	Average Temperature of Oxide, °C. Bottom Grid. On Grid.	Bottom Grid. 6 Inches Up.	Top Grid. On Grid.	Remarks.
June, 1912.				
3	17·0	17·0	16·0	Plant starts work
4	23·2	18·2	16·2	Purifier working
5	28·3	22·6	16·2	,, ,,
6	28·2	27·0	17·3	,, ,,
7	27·2	27·6	17·8	,, ,,
8	28·1	29·4	18·4	,, ,,
9	28·6	29·7	19·1	,, ,,
10	*28·9*	*29·9*	19·8	,, ,,
11	28·7	29·8	20·6	,, ,,
12	28·2	28·9	20·7	,, ,,
13	28·1	29·0	21·0	,, ,,
14	27·3	28·6	20·9	,, ,,
15	26·9	27·9	20·8	,, ,,
16	26·7	27·7	20·7	,, ,,
17	26·9	27·9	20·0	,, ,,
18	26·6	27·7	20·7	,, ,,
19	26·6	28·1	21·3	,, ,,
20	27·0	29·1	21·5	,, ,,
21	27·0	28·9	21·4	,, ,,
22	27·1	29·0	*21·6*	Plant shut down
Average temperature	26·8° C. 80·0° F.	27·2° C. 81·0° F.	20·0° C. 68·0° F.	..

TABLE B.
[Period 1, resting 52 days.]

Date.	Average Temperature of Oxide, °C. Bottom Grid. On Grid.	Bottom Grid. 6 Inches Up.	Top Grid. On Grid.	Remarks.
1912.				
June 22	27·1	29·0	21·6	Plant shut down
,, 23, 24	..	..	..	Purifier resting
,, 25, 26	36·2	*38·8*	24·2	,, ,,
,, 27, 28	*37·4*	37·7	24·4	,, ,,
,, 29	37·2	36·5	24·7	,, ,,
July 1, 2	36·8	36·0	24·1	,, ,,
,, 3, 4	36·5	34·8	23·8	,, ,,
,, 5, 6	36·2	33·5	23·5	,, ,,
,, 8	35·0	32·5	24·0	,, ,,
,, 9, 10	35·0	32·2	23·5	,, ,,
,, 11, 12	34·0	31·7	24·0	,, ,,
,, 13	33·0	31·0	24·0	,, ,,
,, 15, 16	32·0	30·0	24·7	,, ,,
,, 17, 18	31·0	29·7	*25·0*	,, ,,
,, 19, 20	29·7	28·5	24·0	,, ,,
,, 22	28·0	27·0	22·0	,, ,,
,, 23, 24	26·7	25·5	22·0	,, ,,
,, 25, 26	26·0	25·0	22·0	,, ,,
,, 27	25·5	24·5	21·5	,, ,,
,, 29, 30	25·0	24·0	20·7	,, ,,
,, 31, Aug. 1	24·0	23·2	19·7	,, ,,
Aug. 2, 3	22·2	21·7	18·7	,, ,,
,, 4, 5	..	..	..	,, ,,
,, 6, 7	21·5	21·0	18·2	,, ,,
,, 8, 9	21·2	20·7	18·0	,, ,,
,, 10	20·5	20·0	17·5	,, ,,
,, 12, 13	20·0	19·0	17·0	,, ,,
,, 15	..	..	..	Plant restarted

TABLE C.
[Period 2, working 19 days.]

Date.	Average Temperature of Oxide, °C. Bottom Grid. On Grid.	Bottom Grid. 6 Inches Up.	Top Grid. On Grid.	Remarks.
1912.				
Aug. 13	20·0	19·0	17·0	Purifier resting
,, 14	..	..	..	,, ,,
,, 15	19·7	19·0	17·0	Purifier working
,, 16	24·1	21·4	17·3	,, ,,
,, 17	*27·7*	25·2	17·9	,, ,,
,, 18	26·7	25·0	18·4	,, ,,
,, 19	26·6	26·0	18·9	,, ,,
,, 20	..	26·9	19·4	,, ,,
,, 21	26·2	27·1	19·5	,, ,,
,, 22	26·2	26·9	19·2	,, ,,
,, 23	26·0	26·3	19·3	,, ,,
,, 24	26·1	26·8	19·9	,, ,,
,, 25	26·5	27·4	20·2	,, ,,
,, 26	26·4	27·6	20·2	,, ,,
,, 27	26·9	28·3	20·2	,, ,,
,, 28	27·0	27·9	20·2	,, ,,
,, 29	26·6	27·6	20·4	,, ,,
,, 30	26·3	28·2	20·9	,, ,,
,, 31	26·4	28·0	20·9	,, ,,
Sept. 1	26·4	28·0	*21·0*	,, ,,
,, 2	26·3	*28·3*	21·0	,, ,,
,, 3	..	..	..	Purifier resting
Average temperature	26·0° C. 79·0° F.	26·4° C. 79·5° F.	19·6° C. 67·5° F.	

TABLE D.
[Period 2, resting 26 days.]

Date.	Average Temperature of Oxide, °C. Bottom Grid. On Grid.	Bottom Grid. 6 Inches Up.	Top Grid. On Grid.	Remarks.
1912.				
Sept. 2	26·3	28·3	21·0	Purifier working
,, 3, 4	30·4	33·3	21·7	Purifier resting
,, 5, 6	31·7	*34·0*	23·5	,, ,,
,, 7	*32·0*	34·0	*24·0*	,, ,,
,, 9, 10	32·0	34·0	24·0	,, ,,
,, 11, 12	31·5	33·0	23·5	,, ,,
,, 13, 14	31·0	32·0	23·0	,, ,,
,, 15	..	..	..	,, ,,
,, 16, 17	29·5	31·0	23·7	,, ,,
,, 18, 19	28·0	29·5	22·0	,, ,,
,, 20, 21	27·0	27·5	21·0	,, ,,
,, 22	..	..	..	,, ,,
,, 23, 24	24·2	25·0	19·5	,, ,,
,, 25, 26	23·7	23·5	19·0	,, ,,
,, 27, 28	22·5	23·0	18·0	,, ,,

Three thermometers were used, and they were inserted in the oxide at the centre of the purifier—one resting on the grid, and the remaining two with the bulbs placed 6 and 9 inches up respectively. Observations were taken at about ten, one, and four o'clock each day. The results are averaged and presented in Table E.

An average sample of the gas liquor used contained per 100 parts—

Total NH_3	1·690 = 6·56 parts of $(NH_4)_2SO_4$
CO_2	1·795
H_2S	0·202
HCy	0·012

Whence the saturator gases contain per 100 vols.: CO_2, 86·5 H_2S, 12·6; HCy, 0·9.

The amount of liquor distilled during the five days' (47 hours) working period was 9500 gallons, equal to 202 gallons per hour, or 132·5 lbs. of sulphate of ammonia; the volume of CO_2 evolved per hour (by calculation), 295 cubic feet; and the volume of H_2S evolved per hour (by calculation), 42·9 cubic feet. Whence the "rate of fouling," cubic feet of H_2S per cubic yard of oxide, per hour was 42·9 ÷ 11·6 = 3·7.

As sampled, the oxide contained 38·3 per cent. of moisture (loss at 100° C.); and after drying by exposure to air for three or four days, 19·2 per cent. of moisture (loss at 100° C.). Dried at 100° C., the oxide contained per 100 parts: Ferric oxide, Fe_2O_3 = 46·1 (= 51·3 $Fe_2O_3.H_2O$). The maximum absorptive power for H_2S [see Experiment VII.] was:

	Dried Oxide.	Moist Oxide (38·3 per Cent.).
Eight days' test	46·2	= 28·5
Calculated from $Fe_2O_3.H_2O$ content of oxide	51·3	..

Pure $Fe_2O_3.H_2O$ = 100.

The oxide was still rising in temperature when the works tests ceased; the maximum temperature on the fifth day being 30° C. (86° Fahr.) at a point 9 inches above the grid.

TABLE E.

Date.	Atmospheric Temperature, °C.	Average Temperature of Oxide, °C. On Grid.	6 In. Up.	9 In. Up.	Number of Hours at Work.
1913.					
Jan. 27	3·3	22·0	29·3	24·7	10
,, 28	4·4	21·0	27·0	28·0	10
,, 29	5·0	20·7	26·3	27·3	8
,, 30	5·6	20·0	26·0	28·0	9
,, 31	2·8	*23·0*	*29·0*	*30·0*	10

HAMILTON GAS-WORKS.

Mr. J. Ballantyne, the Engineer and Manager of these works, has been good enough to furnish me with an extended series of tests taken at the purifiers working in connection with the vacuum sulphate of ammonia plant. The purifiers are operated singly with alternate periods of rest; air being pumped into the idle purifier. The foul gases from the saturator pass through sulphuric acid to remove the arsenic before going to the purifiers. "Souring" is a chronic source of trouble at these works, and is imperfectly corrected by soda ash. The oxide used during the test was a mixture of artificial oxide and Irish bog ore, which is still in use after thirteen years' work, during which time it has absorbed the waste gases evolved in the manufacture of 2600 tons of sulphate of ammonia.

Each purifier is 18 ft. 6 in. by 16 ft. 6 in. inside, with 18 inches of oxide, having an area of 305 square feet, and holding 457 cubic feet, equal to 17 cubic yards, of oxide. As originally charged, thirteen years ago, the total weight of oxide used in the two purifiers was 21½ tons.

Three thermometers were inserted in the centre of the oxide as in the Motherwell tests, and three-hourly readings were taken. The results are averaged and presented in Table F.

An average sample of gas liquor used contained per 100 parts—Total NH_3, 1·897=7·37 parts of $(NH_4)_2SO_4$; CO_2, 2·180; H_2S, 0·245; HCy, 0·012. Whence the saturator gases contain per 100 vols.: CO_2, 86·6; H_2S, 12·6; HCy, 0·8. The total amount of liquor distilled per hour was 65 gallons, equal to 121·5 lbs. of sulphate of ammonia. The volume of CO_2 evolved per hour by calculation) was 293 cubic feet; of H_2S, do., 42·5 cubic feet; of HCy, do., 2·5 cubic feet. Whence the "rate of fouling," cubic feet of H_2S per cubic yard of oxide, per hour was 42·5 ÷ 17 = 2·5.

Analysis of the Purifying Material before and after 11 Years' Use.

Virgin oxide, part of charge in 1902: Dried in air two days, moisture per cent. 9·7 (loss at 100° C.); dried at 100° C., oxide showed per 100 parts:—

Loss at red heat	32·4
Silica and gangue	11·2
Ferric oxide (Fe_2O_3)	55·0 (= 61·2 $Fe_2O_3.H_2O$)
Difference	1·4

Max. absorptive power for H_2S. (Experiments V. and VI.):

Seven days' test (mean)	54·9	Pure $Fe_2O_3.H_2O$ = 100.
Calc. from $Fe_2O_3.H_2O$ content of oxide.	61·2	

Mixed oxides after eleven years' use in purifier, with occasional addition of 4 cwt. soda ash to correct acidity, with watering: As sampled from purifier, moisture per cent., 12; dried in air three days, do., 2·1; dried at 100° C., oxide showed per 100 parts:—

Loss at red heat (sulphur removed)	6·5
Silica and gangue	1·6
Ferric oxide (Fe_2O_3)	9·8 (= 10·9 $Fe_2O_3.H_2O$)
Sulphur soluble in CS_2	78·4
,, as sulphate	0·1
,, other forms (calculated as FeS_2)	2·5 (= 1·6 $Fe_2O_3.H_2O$)
Ammonia (NH_3)	0·1
Carbon dioxide	*nil.*
Difference	1·0

Maximum absorptive power for H_2S (see Experiment XIII.):

	Dried Oxide.	Moist Oxide (12 per Cent.).
Seven days' test.	9·6	8·4
Calc. from $Fe_2O_3.H_2O$ content of oxide	10·9	9·6

The results of temperature observations are given below:—

TABLE F.

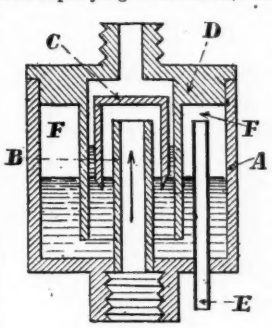
Date.	Remarks.	No. 1 Purifier. Average Temperature of Oxide, ° C. On Grid.	6 Inches Up.	9 Inches Up.
1912.				
Nov. 25	Before starting	(14·0)	(14·0)	(15·0)
,, 25	After starting	19·3	17·3	17·3
,, 26	Working	28·2	31·2	31 5
,, 26	Resting	..	..	..
,, 27	,,	..	..	..
,, 28	,,	..	..	..
,, 28	Working	31·0	35·0	36·7
,, 29	,,	36·3	43·3	45·7
,, 29	Resting	..	..	..
,, 30	,,	..	..	..
,, 30	,,	..	..	..
Dec. 1	,,	..	..	..
,, 2	Working	14·7	15·0	17·7
,, 3	,,	17·7	20·3	23·3
,, 3	Resting	..	..	..
,, 4	,,	..	..	..
,, 5	,,	..	..	..
,, 5	Working	21·7	27 0	28·8
,, 6	,,	22·2	30·8	35·4
,, 6	Resting	..	..	..
,, 7	Working	23·0	34·2	42·0
,, 7	Resting	..	..	..
Maximum temperature reached during test.		*37·0°* C. *98·5°* F.	*45·0°* C. *113 0°* F.	*48·0°* C. *118·5°* F.

Date.	Remarks.	No. 2 Purifier. Average Temperature of Oxide, ° C. On Grid.	6 Inches Up.	9 Inches Up.
1912.				
Nov. 25	Resting	..	..	..
,, 25	,,	..	..	..
,, 26	,,	..	..	..
,, 26	Before starting	(24·0)	(24·0)	(25·0)
,, 27	After starting	29·3	26·3	25·5
,, 28	Working	34·0	36 0	32·8
,, 28	Resting	..	..	..
,, 29	,,	..	..	..
,, 29	Working	37·8	39·2	36·4
,, 30	,,	40·2	46·7	43·5
,, 30	Resting	..	..	..
Dec. 1	,,	..	..	..
,, 2	,,	..	..	..
,, 3	,,	..	..	..
,, 3	Working	32·6	37·4	34·0
,, 4	,,	33·7	46·3	40·5
,, 5	,,	35·0	52·3	47·5
,, 5	Resting	..	..	..
,, 6	,,	..	..	..
,, 6	,,	..	..	..
,, 7	,,	..	..	..
,, 7	,,	..	..	..
Maximum temperature reached during test.		*41·0°* C. *106·0°* F.	*55·0°* C. *131·0°* F.	*50·0°* C. *122·0°* F.

In conclusion, it will not be out of place here to call attention to the interesting account of the working of the oxide purification process at the Stretford Gas-Works which was given by the Assistant-Engineer (Mr. J. Bridge) to the members of the Manchester and District Junior Gas Association on the occasion of their visit to the works in February, 1912.* The conclusions reached by Mr. Bridge as the result of practical experience with respect to the conditions most suitable for the efficient working of the oxide purification process—*e.g.*, moisture content of oxide, temperature of sulphiding, rate and direction of flow of gas, the advantage of an alkaline treatment for sluggish oxide, and the specific effect of gaseous ammonia on the sulphiding process—are in harmony with views expressed in the annual report for 1911, and serve to illustrate the importance of exercising scientific supervision over the sulphiding process.

DISTANCE GAS LIGHTING AND EXTINGUISHING.

A new appliance for lighting and extinguishing gas at a distance was described by M. Aublant in a paper at the last meeting of the Société Technique du Gaz. It is simply a small hydraulic valve actuated from a distance by the turning of a three-way tap. The gas has to be ignited electrically, by a flash-light or by palladium. The arrangement generally does not seem to possess any great advantages compared with the numerous inventions of a similar kind in existence. M. Aublant's appliance, which is shown in the accompanying illustration, has the appearance of a Giroud rheometer, and is about the same size ($1\frac{1}{4}$ to $1\frac{1}{2}$ inches diameter and $1\frac{1}{4}$ inches in height). It consists of a cylindrical box A, through the bottom of which passes a tube B carrying another tube C concentric to it. In the space between these tubes moves a cap or cover D. A small pipe E, connected by a flash-light tube to a three-way tap, effects the lighting. With this tap branched on the gas service, it is possible to send gas under pressure into the appliance, or put the latter into communication with the outer air by chamber F. Levelling is done by mercury. The apparatus is attached to the gas-pipe immediately under the burner it has to control. If, as in the diagram, the gas arrives by the pipe E, the mercury rises in the annular space, and closes the gas-passage. If, on the other hand, the interior of the appliance is put into communication with the outer air, the pressure causes the mercury to fall, and the gas passes freely from the service-pipe to the burner, where it can be ignited.



FURNACE FIRING WITH HEAVY TAR OILS.

The advantage of liquid fuels is particularly apparent where working is only intermittent, and plant has to be brought into use quickly. They are likewise useful for feeding machines of great output employed in foundries, &c.; and also for the fusion of metals requiring great purity, such as copper, brass, bronze, and certain special castings. In England and America, furnaces working with heavy petroleum or tar oil are much in use; but there are comparatively few in France, where manufacturers are reluctant to undertake the trials necessary for each fresh application.

At last month's congress of the Société Technique du Gaz, M. Stein described two burners of his make—one intended for use with Ferguson furnaces, and in reality a small producer which allows of the complete combustion of the oil; in the other, which had been designed for furnaces of small capacity, the oil, instead of being gasified, is simply vaporized by means of a jet of compressed air. The author compared the cost of heating by means of oil, by grate furnaces, and by producer gas. It was 3·65 frs. against 6·2 frs. with producer gas, and 3·29 frs. compared with 6·07 frs. with coke. In a case where the working was intermittent (the furnaces being lighted about once a week), the figures were 4·75 frs. for oil against 10·10 frs. for gas. It was considered that the superiority of the furnaces, due partly to the very slight radiation from them, indicated their use for all classes of intermittent or rapid work.

In answer to a question put by the President of the Society (M. Boutan), on the subject of the very slight radiation indicated at 1500° to 1600° C., which should be proportionate to the difference in temperature of the two walls and to its thickness ($4\frac{1}{2}$ inches), M. Stein pointed out that, as the flames are directed upon the pieces to be heated, the masonry of the furnace, not being directly attacked, does not become very hot. Moreover, as the work of the furnaces is intermittent, the heat has not time to transmit itself to the masonry, which remains comparatively cool during the few hours it is in use. In the case of intermittent working, the employment of tar-oil furnaces does away with the cost of lighting-up and the loss of fuel left on the grate when work is over.

* See "JOURNAL," Vol. CXVII., p. 362.

HINTS ON OPERATING SMALL GAS-WORKS.

One of the papers read at the last annual meeting of the Iowa District Gas Association was on "Improving Operating Conditions on Small Gas-Works;" the author being Mr. H. G. STILLSON. In the course of it he made the following remarks.

Preventing waste of the raw materials from which we make our gas is, next to labour, the most important. For instance, too many checks cannot be made by the manager and his plant representative. Examine the car before and after unloading the oil, looking after measurements and shortages, deleterious substances, and specific gravity. Above all, take care in handling this, now the dearest of all the basic elements of gas manufacture. The oil must be followed and checked from the tank-car to the gasholder. Do not use even a trifle more in the set than is absolutely necessary. If you allow your gas maker to do so, it is waste pure and simple, and results in good money winging its way through the stack-valve, during blow and run, and depositing excessively in seals, drips, and relief holder.

Here it is well to take up the waste of water-gas tar. It is used in different ways, such as burning under boilers or for paints, &c. Watch it and get the money out of it, as it is valuable. In this same way the coal, coke, and other materials must be handled—nothing being too small to escape your closest scrutiny; for leaks may exist where the most honest exterior appears. Careless charging of water-gas machines, coal-gas retorts, and furnaces can account for high costs. But here again consult your handbook or data on gas manufacture. One of the hardest situations is when you know your apparatus is unbalanced, and has not sufficient capacity for more economical manufacturing costs. When this is the case, it is often cheaper to pay interest on enough money to put your plant in good proportion to your output than to continually lose by operating the old machinery.

Next in order is purification, for, as the real gas man tells us, "Next to no gas is dirty gas." Most of us have four boxes, arranged so that one can be cut out for change and leave one box always clean at the end of the series, and this one showing clean gas at the inlet, not at the outlet. This test means continuous exposure of lead acetate paper to a jet of gas. Calculate the cubical contents of your boxes (considering but three, if you have four); and if you have 5 cubic feet of oxide per 1000 cubic feet per day's run (meaning the time that you are passing gas through the boxes) you should always have clean gas in front of the last box. If you do not, you are at fault in that you do not provide proper material, or do not change the oxide according to a regular schedule.

Machinery is one of the places where we fail, no matter how particular we are. The manager cannot be going round the plant continuously; but some of the machinery is running for at least 12 hours daily, and much of it 24 hours, and is it always getting enough oil and care? Some men are glad to hurry away from their plants because they always hear a knock, a squeak, or a rattle; and they say: "Well, as that engine has run for five years with little care, I guess it will turn around a few years yet."

We all know the two stages of machinery—when it is in fine condition, and when it is broken down; but we do not know when it is really first ailing. Where there is much machinery, it certainly pays to have a man who is handy and careful. For instance, the boilers. We all have either two or more, and a time when the one can be down for examination and repair, having a thorough washing at least once a fortnight or oftener. This washing must be regular, and recorded each time upon the manufacturing record. If you are too busy, have some responsible boiler man of your city there to criticize or repair, as the case may need. Do not allow inexperienced men to pass an opinion upon or repair the boilers. Flue scraping is imperative, and $1 put in a good scraper will save many times its price in coal. But, after you buy one, see that the men use it, as there appears to be an idea that blowing the flues with steam does all that is necessary. This is a good supplement to scraping, but alone it will clog up the back end of the flues. Put the flue scraper through at least twice every twelve hours of full load on the boiler.

The exterior and interior of your buildings not only give outsiders an idea of your management (who also may be fooled with a little whitewash and paint), but, most important of all, create a feeling among your men that you are careful and painstaking; and they will attempt to do things in a neater manner.

The manager should study carefully each morning the entire manufacturing data as compared with the previous day and the corresponding day in the preceding month. He will then be able to check errors and losses, and then correct them before it is too late, and will not be surprised by the regular monthly report showing things he did not know before. Put off nothing until the morrow. The procrastinator is always about a lap behind.

While not exactly concerned with the good operation of the plant, it is well to mention that a recording pressure-gauge is indispensable; and no manager can afford to be without one. The manager of the small works is paid less and considered less than his brother with the large company, while his duties are of a more general and particular nature. This is probably one of the ironies of fate. Though his problems are at times well nigh his limits, he has the satisfaction of being one of the most important links between the public and the gas industry, which ranks fourth in the great industries of the world.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Brick-Built v. Moulded Retorts in Vertical Installations.

SIR,—I gather from your "Editorial Note" in the issue for the 8th inst., that some questions have arisen, and doubts prevail, as to the relative merits of brick-built and moulded retorts for vertical retort installations; and I venture to again call attention to the long-established practice in the Scottish oil industry of the use of brick-built retorts.

When I first ventured, in January, 1906, to contribute to the "JOURNAL" some articles upon the adaptation of the vertical retort principle to coal-gas manufacture, I referred to the Scottish practice, and the special form of brick employed was described. It was further pointed out that the wear and tear on the interior of such retorts had a tendency to reduce their substance—this being caused by the slipping of the charge—to sometimes from 2 to 3 inches in thickness from the original 6 inches.

When I first had occasion to put up a small installation of vertical retorts in Edinburgh at the request of the Commissioners, I naturally followed this practice; and in the issue of the "JOURNAL" for April 12, 1910, there appeared some photographic illustrations, together with a description of the Edinburgh installation, communicated (in my absence) by Mr. Masterton to the "Informal Meeting" of Scottish Gas Managers.

The illustrations on p. 110 of that issue, however, clearly show the form of the grooved-and-tongued brick composing the six retorts; the central chambers illustrated being waste-gas flues with secondary air chambers on either side. The illustrations also show the methods employed for staying its structure (which in this case is only 4½ inches thick) to resist distortion caused by the internal stresses, and the rise and fall due to expansion and contraction.

This setting has been worked for a more or less lengthened period, and has a capacity of from 18 to 20 tons per day. Experience of its working conclusively establishes the superiority of the brick-built retort over the moulded form; and when one reflects upon the characteristics of both, some wonder arises in one's mind as to the moulded retort ever being applied to such a purpose.

Expansion and contraction are inevitable in any such structure. When the expansion can be distributed over a multitude of horizontal and vertical planes, it must be infinitesimal in extent and effect as compared with the same measure of expansion in an unjointed mass, which must in the first instance subject the structure to such strains as to cause unequal and large fractures more or less localized.

In the case of the brick retort, the fractures are necessarily along the line of cleavage of the parts, and do not, therefore, interfere with the true form of the structure. When, however, the same measure of expansion takes places in a plastic built-up retort, it is impossible to foretell the line it will take, and, therefore, cross stresses in its structure, and inequality of movement and form, are inevitable.

Furthermore, in the case of contraction where the lines of expansion are uniform the lines of contraction will be similarly so; but where the lines of expansion are irregular, then the line of contraction is likewise irregular, and this in itself will produce additional fractures.

I cannot illustrate my point better than by reference to structures which are common in every town—viz., brick-built chimney stalks. Those of us who know a little more about them know that there is often an inner lining of brickwork which is spaced apart from the body of the chimney and which will rise 100 feet or more in the form of a 4½-inch wall only. That brick-built chimneys of comparatively light construction have withstood stresses of every imaginable kind, internal and external, must be within the knowledge of any one who is likely to read these lines. Their stability under all these changing conditions is evidence of the correctness of my theory that a brick-built retort for verticals is right.

Who would for a moment expect (say) a 20 feet or even a 10 feet high chimney, built of a previously burned plastic mass, to remain in position for long after it was once put into operation.

As to the gas-tightness of a brick-built retort as compared with the plastic-built retort, so far as this depends upon its structural character my own experience conclusively proves the superiority of the brick-built structure over the plastic-built structure—no doubt due to the simple fact that the line of cleavage, or cracks due to expansion and contraction, are more readily again sealed by the carbon resulting from distillation, whereas in the plastic retort the cracks may be anything from one-eighth inch and upwards.

Our records show that, as compared with inclined retorts of plastic build, the nitrogen content, using the same coal and under similar conditions as to yield, is from one-third to one-half less in volume.

W. R. HERRING.

Palace Chambers, Westminster,
July 16, 1913.

Herr Körting on Gasholders.

SIR,—With respect to your comments on my letter of July 15,

The misunderstanding (a very pardonable one) has not been mine, but that of the writer of the article in the "JOURNAL" for July 8. The article comments on Herr Körting's contention that a shallow-lift holder is "harder to guide" than a deep one, in these words:

> "As to his [Herr Körting's] point that a shallow lift is harder to guide than a deeper one of less diameter, Mr. Herring, the Engineer for the Granton holder, would say that the paramount object *of* constructing gasholders with shallow lifts is to ensure the level ascending and descending of the inner lift when it is working alone."

If this comment means anything, it means that the "object of," or reason for, making the inner lift shallow is to ensure its level working. This is a fallacy it would not be safe to pass over. Hence my letter of the 15th inst.

But the writer of the article has evidently quite misunderstood

Mr. Herring, as further consideration of the extract from his book, upon which he appears to have based this assumption, would show. Mr. Herring says (I am quoting from your footnote to my letter):

"The principal object *in* the construction of gasholders with shallow lifts is to ensure the level ascending and descending of the inner lift when it is working alone."

Now this, when read with the context, although very vaguely expressed, doubtless means the very opposite to the inference excusably drawn from it by the writer in the "JOURNAL." It means that the principal difficulty to be overcome when designing a shallow-lift holder is the tendency of the inner lift to get out of level when rising or falling alone; and it must be the object of the designer to cope with it. He recognizes the difficulty, and the extra care required in this case, as compared with deep lifts.

Experience has shown, and instances might be cited to prove, what a mess one may get into, unless special care is taken in this respect—care which no gasholder of ordinary proportions (say, 1 to 4 or 5) ever demands. I do not recommend 1 to 7, as that is the *outside limit* for anything approaching economy or true working.

Frying-pan holders (such as 1 to 7) are a decided mistake if they can be in any way avoided; and Herr Körting is quite right on this score. There are circumstances, however, where it may be impossible or impracticable to avoid them; and East Greenwich was one of them.

I think Mr. Herring is the gainer by the discussion, as, but for the fact that I drew attention to the fallacy he was represented as favouring, it would have been laid to his door by all who, like myself, have not read his description of the Granton gasholder.

F. S. CRIPPS.

Westminster, July 18, 1913.

Practical Hints for Building Large Gasholders.

SIR,—Allow me to refer to your article in this week's issue and Herr Körting's paper read before the German Association.

It may be of interest to state that the holder in course of construction at Huddersfield is designed with five tiers of circumferential girders. The four lower ones are arranged to be fixed flat; while the top tier is to be vertical. These girders are not designed with a view to their employment as inspection platforms, though they may occasionally happen to be in the correct position for such service, but to give greater stability to the structure as a whole.

According to Herr Körting, it would also appear that it is only necessary to inspect the cup and dips and guide-rollers when the holder is fully inflated, or when exactly two lifts or more are inflated. This may be so for (say) a half-yearly examination; but accidents sometimes occur just in the position least anticipated.

Mr. F. Southwell Cripps's work on "Gasholders" is indispensable in the designing of gasholder framing; and I should like to endorse your suggestion that he would kindly republish the same. To no one is the gas profession more indebted upon the subject of gasholders than to Mr. Cripps.

EDWARD A. HARMAN.

Huddersfield, July 16, 1913.

Jet Photometers.

SIR,—We have noticed an article which appeared in your issue for July 8, p. 105, by Mr. A. Renfred Myhill, of Birmingham, entitled "The Jet Photometer as an Instrument for Testing Illuminating Power."

Mr. Myhill therein writing from an outside point of view apparently, discusses many aspects of a jet photometer which are, we are sure, common knowledge to nine gas engineers out of ten; but he also raises several points of objection to the construction of the instrument as ordinarily made and employed.

Messrs. Carr and Nairne's patent jet photometer (of which we are the manufacturing licensees) meets every objection raised by Mr. Myhill; complies with every point which he notes as being essential; and goes further in embodying ideas of which Mr. Myhill when he wrote his article took no cognizance. The possibility, for instance, of using a jet photometer as an approximate guide to calorific power when properly rated, and by the employment of a special calibration and scale, is one of the points covered by the patents of the afore-mentioned engineers. But the salient point—*i.e.*, the constant testing of crude gas so that its finished value can be known within a minute or two—which Mr. Myhill refers to, is one which was originally covered by Messrs. Carr and Nairne.

We think it only right to ask you to kindly publish this short communication in order that Messrs. Carr and Nairne should have the credit for the work they have done in the matter of jet photometers.

ALEX. WRIGHT AND CO., LTD.,
per JOHN F. SIMMANCE, Managing-Director.

Westminster Palace Gardens, S.W., July 16, 1913.

The above letter was submitted by Messrs. Wright and Co., in draft, to Mr. Myhill, and yesterday the following reply to it was received for publication.

SIR,—I believe Messrs. Alexander Wright and Co. are writing to you (or have already written) on the subject of my article on jet photometers, recently published in the "JOURNAL."

The article was written, of course, with reference to the ordinary type of jet photometer; and it was intended to point out the fallacy of relying solely, or nearly so, upon the indication of a jet photometer as a guide to the quality of the gas, without making frequent tests with some other more reliable instrument, as a check on the jet readings. As Messrs. Wright say, it is quite possible that the knowledge may be common to nine out of ten engineers, but I have met "No. 10" (for whom the article was intended) on so many occasions, that perhaps the advice is worthy of repetition.

With regard to Messrs. Carr and Nairne's patent jet photometer, I have had no practical experience of it. From what I understand of its construction, there is no reason whatever why it should not be an excellent and a reliable instrument, in its place; but while we are still burdened with a legal illuminating power standard, the gas must be tested from time to time, with parliamentary standards, in order to be safe.

The epitome of my reply to Messrs. Wright is that my article referred to the ordinary jet photometer, while their letter speaks of a special type which I have never condemned, nor do I intend to. I cannot do better than quote from their own catalogue and price list: "Neither the jet photometer nor the illuminating-power meter is of the slightest use where water gas is made." This was a point on which I laid particular stress in my article; yet there are very many gas engineers who pretend to measure the illuminating power of their town gas (containing varying proportions of water gas) by means of the jet photometer.

In conclusion, I should like to thank Messrs. Wright for their courtesy in sending me a copy of their letter before publication in the "JOURNAL."

A. RENFRED MYHILL.

Birmingham, July 19, 1913.

The Recent Alleged Irregularities at Weston-super-Mare.

SIR,—Will you have the goodness to insert the enclosed paragraph in your next issue, and much oblige,

J. E. NORMAN, Chairman.

Weston-super-Mare, July 16, 1913.

[ENCLOSURE.]

It will be remembered that a short time since we reported certain irregularities (which were the subject of an inquiry by the Committee of Stockholders) on the part of a Director and an official of the Weston-super-Mare Gaslight Company. The name of Mr. E. L. Spreadbury, the Inspector of the Fittings Department, was mentioned; and inferences were drawn detrimental to Mr. Spreadbury's reputation. Since the investigation, additional evidence has been produced which tends to show that Mr. Spreadbury did not receive the full measure of justice he was entitled to. Under these circumstances, the Directors were prepared either to reinstate or compensate him. The Directors, however, have received a letter from Mr. Spreadbury, stating he would prefer the latter alternative. The Directors desire to say that Mr. Spreadbury leaves their employ without the slightest imputation against his character or business ability.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Scotch Bills read the first time and deemed to have been read a second time: Dunfermline District Water Order Confirmation Bill, Kirkcaldy and Dysart Water Bill.

Bill read a second time: Barry Urban District Council Bill.

Bills reported: Blyth and Cowpen Gas Bill, Liverpool Corporation Bill, Pontypridd and Rhondda Joint Water Board Bill, Silloth Gas Bill, West Bromwich Corporation Bill.

Bills read the third time and passed: Aberystwyth Corporation Bill, Bournemouth Gas and Water Bill, Local Government Provisional Order (Gas) Bill, Morley Corporation Bill, Titchfield District Gas Bill.

The Barry Urban District Council Bill has been referred to a Select Committee, consisting of the Marquis of Winchester (Chairman), Lord Latymer, Lord Monson, Lord Farrar, and Lord Stanmore; and they commenced sitting yesterday.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Lords Bills read the first time and referred to the Examiners: Aberystwyth Corporation Bill, Morley Corporation Bill.

Lords Bill read a second time: Gas Orders Confirmation Bill.

Lords Bills reported: Ebbw Vale Water Bill, Huddersfield Corporation Bill, Worthing Gas Bill.

Bills read the third time and passed: Broadstairs and St. Peter's Urban District Council Bill [Lords], Dunfermline Corporation Water Order Confirmation Bill, Dunfermline District Water Order Confirmation Bill, Leeds Corporation Bill [Lords], Llantrisant Gas Bill [Lords], Tynemouth Gas Bill [Lords], West Hampshire Water Bill [Lords].

PROGRESS OF SUNDRY PRIVATE BILLS.

The Unopposed Bills Committee of the House of Lords had before them last Tuesday, and sent forward for third reading, the following measures.

Biddulph Gas Order.—This was included in a Confirmation Bill. Under the Order the Council take over the Biddulph, Bradley Green, and Black Bull Gas Company, and acquire all the powers of a statutory gas authority. The maximum price under the Order is 5s. 6d. per 1000 cubic feet.

Local Government Provisional Orders (No. 7) Bill.—This Bill contained, among others, the following: (1) Briton Ferry Order, which authorizes the Council to use additional lands for gas purposes. (2) Cleckheaton Order, which sanctions the borrowing by the Council for gas purposes of £50,000. (3) Wombwell Gas Order, which repeals and modifies the existing gas powers of the Council in some minor respects. The use of additional land for gas purposes is also authorized.

TUBE RAILWAY BILL AND GAS-MAINS.

The House of Commons Committee who have been considering, at intervals during the past two or three weeks, the proposal of the Postmaster-General to construct a tube railway from the east to west of London, dealt on Tuesday last week with the opposition of the Gaslight and Coke Company. There were, of course, a large number of other petitioners against the Bill.

Mr. J. D. FITZGERALD, K.C., Mr. CLODE, K.C., and Mr. SZLUMPER, were Counsel for the Bill. The Gaslight and Coke Company were represented by Mr. BALFOUR BROWNE, K.C., and Mr. PITMAN.

Mr. *D. Milne Watson*, the General Manager of the Gaslight and Coke Company, said the proposed tube railway passed through districts in which the Company's mains were laid; and the question of the mode of construction and working of a line of this kind was a very important matter from his point of view. Any disturbance, however slight, was apt to cause the joints of the mains to go.

The CHAIRMAN (Sir G. Baring): Have you ever suffered damage from other tube railways?

Witness said that the construction in the case of the ordinary tube railways was at such a depth that he did not think it was likely they had suffered any damage. His broad case against the Bill was not only that arising out of leakage from the mains there would be loss to the Company, but there would be danger to the public. His only desire was to see the Company adequately protected. One of his great objections to the Bill was in respect of clause 6, which reads as follows:—

(1) The railway may be worked by electrical power, and for the purpose of working and lighting the railway, and generally for the purpose of the Post Office, the Postmaster-General may lay down along the railway, and maintain and use, cables, mains, lines, and apparatus for transmitting electrical energy.

(2) The Postmaster-General may transmit, transform, and use for the purposes of this Act electrical energy generated or transformed at any Post Office generating station or sub-station, and for the transmission of such electrical energy may lay down and maintain all necessary and convenient cables, mains, lines, and apparatus, and the Postmaster-General may enter upon, and open and break up, streets and other public places for the purpose, subject, however, to the following provisions and restrictions—that is to say:

(*a*) He shall with all convenient speed complete the work on account of which he opened or broke up the same, and fill in the ground and make good the surface, and generally restore the street or place to as good a condition as that in which it was before being opened or broken up, and carry away all rubbish occasioned thereby.

(*b*) He shall in the meantime cause the place where the street or public place is opened or broken up to be fenced and watched, and properly lighted at night.

(*c*) He shall pay all reasonable expenses of keeping the street or public place in good repair for six months after the same is restored, so far as such expenses may be increased by such opening or breaking up.

(4) The Postmaster-General and any company, authority, or person having power under any Act of Parliament or Order confirmed by Parliament to supply electrical energy may make and carry into effect agreements and arrangements for the supply of electrical energy to the Postmaster-General for the purposes of this Act, and for executing any works or providing any apparatus necessary for the purposes of such supply; but nothing in this sub-section shall authorize any such company, authority, or person to break up the surface of any public street or place.

This, in addition to giving the Postmaster-General power to work and light the railway, gave authority to use his electrical energy for all Post Office purposes, and to break up streets, which would include the lighting of Post Office buildings, and the supply of energy for power purposes in those buildings. At the present time the Gaslight and Coke Company supplied a large quantity of gas to the Postmaster-General for the purpose of lighting and heating post offices round London. The bill for this last year amounted to £12,700; and he objected very strongly to the Postmaster-General obtaining powers under a measure of this character to compete with his Company for the supply of gas in this way. For the year before last, the bill of the Gaslight and Coke Company with the Postmaster-General was £11,800. In the year before that, it was £11,700. So that it was a growing account. Whatever the intention of the Postmaster-General might be, the fact remained that clause 6, as it stood in the Bill, enabled him to supply post offices all over London, and not merely on the line of the railway. The words in the clause which were strongly objected to were "and generally for the purpose of the Post Office," which indicated that there would be no restriction upon the powers in the way complained of. If the clause were restricted to the lighting of post offices on the line of the railway, he would not have the same objection. Then, again, there was nothing in the Bill, if the Postmaster-General obtained the full powers he asked for, which placed him under the general law according to the Gas-Works Clauses Act or the Electric Lighting Acts. In the event of the Bill passing, these restrictions should be placed upon the Postmaster-General, who would be an ordinary trader, and should be subject to all the restrictions applying to ordinary traders. For instance, the Gas-Works Clauses Act required compensation for damage done, and it also gave the road authority jurisdiction as to the mode of breaking up streets; while under the Electric Lighting Clauses Act there were mutual powers given to owners of pipes to alter the position of each other's pipes, and the conditions were laid down. None of these provisions were at present proposed to be applied to the Postmaster-General. Another matter to which he wished to draw the attention of the Committee was the clause relating to electrolytic action. There was a Model Clause dealing with this matter which the Postmaster-General always insisted upon in the case of other people, and yet in this instance he did not propose to apply it to himself. A clause had been suggested which gave a certain protection so far as it went in the case of electrolytic action; but it did not provide that the Postmaster-General should comply with the Board of Trade regulations in the matter, as was the case in the Model Clause. He did not wish to be put in any higher position against the Postmaster-General than he would be against other people; but he claimed that the ordinary Model Clause relating to electrolytic action should apply. Another matter was that gas-pipes should be placed in the same category as property in respect of compensation for damage done in the working of the railway, and there were precedents for this in several tube railway Bills. A further point was that at Finsbury Pavement the Post Office tube would probably be under construction at the same time as the extension of the Great Northern and City Railway Company; and the Gas Company asked for protection against the Postmaster-General as well as the Railway Company in the event of damage occurring to the Gas Company's pipes at this point. The suggestion was that there should be a right of claim against the Post Office, leaving the Railway Company and the Post Office to determine who caused the damage, if any. Such a clause had already been inserted in a tube railway Bill.

Mr. FITZGERALD pointed out that the provisions of the Railway Clauses Act dealing with the disturbance of gas-mains had been incorporated in the Bill, and suggested that this dealt with most of the points raised by the witness.

Mr. BALFOUR BROWNE contended that this was not so. The Railway Clauses Act referred to works by the railway company; whereas the Gas Company required the Postmaster-General to do certain things in order to protect them.

The CHAIRMAN at this stage asked if it were not possible to agree on some of the details.

Mr. FITZGERALD, in cross-examination, explained that there was no scheme on the part of the Post Office to extend their mains all over London for the purpose of lighting the post offices. The Postmaster-General, he said, merely wanted to light the post offices on the line of the railway; and if by any chance a post office had to be extended, and further buildings taken, say across the road, then the right was taken to carry the mains there. Witness replied that crossing the street brought in all the difficulties of laying mains, and necessarily interference first with the Gas Company's business and, secondly, with the mains which were already existing. On the question of electrolytic action, Counsel explained the parliamentary position with regard to compensation—namely, that since the report of Lord Cross's Joint Committee some years ago it was now the practice to insert a Model Clause to the effect that, provided the undertaker complied with the Board of Trade regulations, no action could lie against him for any damage for electrolytic action. No compensation could be claimed unless the undertakers had been guilty of default in not complying with the Board of Trade regulations. Under the proposed clause, however, the Gas Company could claim compensation if reasonable precautions were not taken. The only difference in this case was that the Postmaster-General would not be under the Board of Trade, which was another Government Department. Witness replied that his view was that unless the Post Office adopted the Model Clause, and came under the Board of Trade, compensation should be paid whether reasonable precautions were taken or not. He preferred, however, to be under the Model Clause, which the Postmaster-General always insisted upon in connection with others.

Mr. BALFOUR BROWNE, in addressing the Committee, first referred to a remark by Mr. Fitzgerald in his opening speech—that the Post Office was in the same position as any other private trader in this country—namely, that it was open to him to lay mains for electricity, provided he did not leave his own land. This, however, was not the case at all. It was quite true that the Postmaster-General, if he chose, could generate electricity at St. Martin's-le-Grand, and supply that building with electricity. But under the Bill, for the convenience of the Post Office, he was driving a tube all through London; and under cover of this tube he was carrying electric mains which would enable him to supply houses in the ordinary sense of the word—*i.e.*, post offices. So long as he merely took the railway through London for the purpose of carrying the mails to various parts, the Gaslight and Coke Company could have nothing to say against the scheme if the country desired it, although it did not appear to him to be a very necessary scheme. And if the Postmaster-General desired to supply himself with electric current for driving the trains along the tube, he ought to be enabled to do so, and also for lighting the stations. Anything above this, he contended, was beyond the real meaning of the Bill. The Postmaster-General was now going to supply post offices over the tube stations, which were no part of the enterprise, and in this way he could deprive the Gaslight and Coke Company of a very valuable customer. Why should the Post Office be allowed to become a purveyor of light in London? Hitherto the gas and electric lighting companies had a monopoly, inasmuch as nobody else had the right to break up streets for the purpose of selling either of these commodities, and more particularly did he object now that Mr. Fitzgerald had intimated that he did not even only desire the powers to supply post offices along the route of the railway, but wanted to cross the road. Under section 6 there was no limitation; and the Postmaster-General could break up streets all over London and supply electricity—a proposal which he asked the Committee not to sanction. The powers should be limited to the supply of electricity for working the trains and lighting the stations. In regard to bringing the gas-pipes within clause 17, "Compensation for Damage by Working," he did not know why the Gas Company's property, because it was in the roadway, should be distinguished from houses on the sides of the roads. Gas-pipes were liable to the same injury as was ordinary property; and he claimed the right of compensation if any damage was done. On the question of the electrolytic action, the general law was to the effect that the Board of Trade made regulations, and any contravention of these regulations was subject to a penalty. Here there was no penalty; and he asked the Committee either to place the Postmaster-General under the Model Clause or give compensation.

On Wednesday, in the course of his final speech on behalf of the Postmaster-General, Mr. FITZGERALD, dealing with the position of the gas and electric light companies, said that the powers of the Bill were simply to enable the lighting of post offices, which would necessarily

have to be over the stations to be constructed under the Bill, and, in addition, of course, to light any extension of these post offices, even if they might be on the other side of the street. If the Bill passed, he would bring up an amendment to carry this out. The Postmaster-General could undoubtedly light them much cheaper than the companies. With regard to electrolytic action, that was an important matter which certainly had been settled by the action of Parliament during the past ten to fifteen years. The point really was that the Postmaster-General, like a tramway company or an electric lighting company, obtained powers to use electricity; and unless certain precautions were taken there would be an escape of electricity, to put it in general language, which might cause electrolytic action to gas or water pipes. If certain reasonable precautions were taken, however, there was no liability for compensation. The Postmaster-General, under the Bill, would have just as much right to the use of the streets as the existing companies; and there was no reason, so long as he was not negligent, why he should pay for damage by electrolytic action. It was not possible to prevent it absolutely. The recommendation of Lord Cross's Committee had, as had already been stated, resulted in the drafting of a standard clause, and the substance of it was that precautions stipulated by the Board of Trade had to be adopted. If this were done, no compensation could be claimed. The Postmaster-General, under his proposed clause, intended to do exactly the same, and, indeed, in one point this clause was more favourable to the gas companies than the ordinary clause. The Postmaster-General was to be put under an absolute obligation to take all reasonable precautions. If he did not, then he would be liable for damage; and the damage could be recovered from him by action. The only substantial matter in which the proposed clause differed from the Model Clause was that in the latter it was the Board of Trade who laid down what the reasonable precautions were to be. But the reason that this had not been inserted in the Bill was that as between Public Departments he was informed it was not usual for one Department to be put under the control of another. In other respects he contended that the opposition was in a more favourable position than under the Model Clause. What the Gaslight and Coke Company had been asking would be to reverse the policy of Parliament for the last ten or fifteen years, and place upon the Postmaster-General an absolute liability for any damage by electrolytic action, whether caused by want of care on his part or not; and it would also reverse the general law, which did not place him under such an obligation.

Mr. PITMAN, interposing, said that the Gaslight and Coke Company asked for the Model Clause.

Mr. FITZGERALD replied that in his opinion the proposed clause of the Post Office was more favourable than the Model Clause.

Consideration of Clauses.

The consideration of clauses occupied the Committee during part of Wednesday and Thursday. One or two of the points raised by the Gaslight and Coke Company were covered by decisions on other petitioners' clauses. For instance, the Great Eastern Railway Company wished to put the Postmaster-General under a similar clause with regard to electrolytic action as that outlined on behalf of the Gas Company—namely, that either the Model Clause should be inserted in the Bill, or that the Postmaster-General should be under an absolute liability to pay for any damage which might be occasioned, irrespective of whether reasonable precautions were taken or not.

The Committee refused to insert this clause for the protection of the Great Eastern Railway Company, and, obviously, this decision applied equally to the opposition of the Gaslight and Coke Company in this matter. Below is given the clause which will go into the Bill:—

Provisions as to Use of Electrical Power.

The following provisions shall apply to the use of electrical power for the purpose of working the railway, unless such power is entirely contained in, and carried along with, the carriages:—

(1) The Postmaster-General shall employ either insulated returns or uninsulated metallic returns of low resistance.

(2) The Postmaster-General shall take all reasonable precautions in constructing, placing, and maintaining his electric lines and circuits and other works of all descriptions, and also in working the railway so as not injuriously to affect by fusion or electrolytic action any gas or water pipes or other metallic pipes, structures, or substances, or to interfere with the working of any wire, line, or apparatus of any company or authority supplying electrical power under statutory powers, and from time to time used for the purpose of transmitting electrical power or the currents in such wire, line, or apparatus.

(3) At the expiration of two years from the opening of the railway the provisions of this section shall not operate to give any right to claim in respect of injurious interference with any electric wires, lines, or apparatus, or the currents therein, unless, in the construction, erection, maintaining, and working of such wires, lines, and apparatus all reasonable and proper precautions, including the use of an insulated return, have been taken to prevent injurious interference therewith and with the currents therein by or from other electric currents.

(4) If any difference arises between the Postmaster-General and any other party with respect to anything in this section contained, such difference shall, unless the parties otherwise agree, be determined by an arbitrator to be appointed by the Board of Trade, and the costs of such determination shall be in the discretion of the arbitrator.

With regard to the question raised by the Gas Company and some others as to preventing the Postmaster-General from supplying electrical energy for lighting post offices other than those on the direct line of route.

Mr. FITZGERALD, on behalf of the Post Office, offered a clause, which the Committee decided to put in, to the effect that electricity shall be supplied only for working the railway and lor lighting post office premises along the route, and within 50 yards.

The CHAIRMAN, with regard to clause 6, given above, pointed out that the Committee thought the words objected to by the Gaslight and Coke Company "and generally for the purposes of the Post Office" as being too wide, and suggested that other words should be inserted.

A clause put in for the protection of the Gaslight and Coke Company, practically by agreement with the Post Office, was to the effect that the Postmaster-General shall not raise or alter the position of any mains belonging to the Company in such a manner as to leave them at a depth of less than 3 feet or more than 5 feet from the surface.

Some discussion took place with regard to a proposal on behalf of the Gas Company that the Postmaster-General should submit to a clause, very generally put into Tube Railway Bills, penalizing him to the extent of £10 per hour in the event of any cessation of supply of gas to consumers through interference with the Gas Company's mains. This was strongly resisted on behalf of the Post Office, for whom Mr. Szlumper offered to insert a clause providing for the payment of compensation in such a case, instead of the absolute penalty being inserted in the Bill. For the Gas Company, however, it was pointed out that compensation would involve the necessity of proving the extent of the damage before the amount of compensation could be fixed; and eventually the Committee decided to insert the clause asked for.

MIDDLESBROUGH EXTENSION.

Gas Companies' Opposition.

HOUSE OF COMMONS COMMITTEE.

(*Before Colonel* BATHURST, *Chairman*, *Sir* GEORGE AGNEW, *Mr.* O'DOHERTY, *and Mr.* SAMUEL SAMUEL.)

The inquiry into the proposed extension of the Middlesbrough municipal boundaries [see *ante*, p. 187] was continued last week; but the bulk of the evidence was on general matters and not specifically on the gas question. It was not until Wednesday that the official witness for the Corporation to deal with the gas position came before the Committee; and on Thursday, as will be seen below, the whole position was considerably modified by an intimation from the Chairman as to the opinion of the Committee so far as the case has gone at present.

Counsel for the Bill were Mr. BALFOUR BROWNE, K.C., Mr. W. J. JEEVES, and Mr. W. HEDLEY. The South Bank and Normanby Gaslight and Coke Company were represented by Mr. CLODE, K.C., and Mr. NIXON; while Mr. G. W. BAILEY appeared on behalf of the North Ormesby Gas Company.

Mr. *J. Calvert*, the Chairman of the Gas and Electricity Committee of the Corporation, spoke as to the charges for gas in Middlesbrough as compared with the outside districts, which have already been given. In Ormesby, if the consumers were charged the same price as in Middlesbrough, they would effect a saving of £1896 per annum; while with regard to South Bank the similar saving would be £3186.

In cross-examination by Mr. CLODE, on behalf of the South Bank and Normanby Company, the point was emphasized that the Middlesbrough Corporation, although they had had powers to supply gas in the Company's area for 46 years, had never thought fit to exercise them. Counsel also drew attention to the possibility open to the Corporation, if the extension of the Order were granted, of immediately starting competition with the Company, with a view to depreciating the value of their undertaking when the question of purchase arose later, as it undoubtedly must do.

Witness said that, in his opinion, the Company ought not to be prejudiced by the extension; but, on the other hand, they should not be put in a position to be benefited by anything done under the present Order. He agreed with Counsel that the Corporation could do as was suggested in the matter of depreciating the Company's undertaking with a view to ultimate purchase, but said that the Corporation had no intention of competing. At the same time, he quite realized that the mere extension of the Corporation's powers under the new conditions might prejudice the Company in the question of sale.

Mr. CLODE put it to witness that the practice of Parliament was to repeal such old unexercised powers, and that he was going to ask the Committee to do so in this case.

Mr. JEEVES, for the Corporation, said he was authorized to state that while they regarded the existing gas powers as of importance to them, yet there was no desire to depreciate or appreciate the Gas Companies' undertakings. Therefore he would be willing to have a clause in the Order repealing the Corporation's existing gas powers, on condition that the Companies agreed to sell their undertakings (say) within the next two sessions of Parliament on the terms of the Lands Clauses Act. The conditions, of course, would be that the Gas Companies would not be affected either one way or the other in the matter. In other words, the arbitration for the purchase would take place exactly as if the conditions were as they existed to-day—*i.e.*, with full knowledge of the Corporation not having competed with the Company in its area.

Mr. BAILEY: Does that apply to both Companies?

Mr. JEEVES: Yes, certainly.

Mr. BAILEY cross-examined briefly on behalf of the North Ormesby Gas Company, and rather suggested that the proposal to purchase, as made by Mr. Jeeves, would not altogether satisfy him. At any rate, the ratepayers of the district had not yet had the question before them, and it would be a serious matter to have such powers of purchase on the part of the Corporation hanging over their heads for one or two years, and then for the ratepayers to refuse to sanction the purchase. It would interfere with the raising of capital by his Company, who were at present at the end of their capital powers and would soon have to obtain more.

Witness, in re-examination, said that the whole question of purchase had been relegated to the Parliamentary Committee of the Corporation to negotiate on the terms indicated by Mr. Jeeves.

Early on Thursday it was ascertained that negotiations for the purchase of the two Companies were in progress, and that, in fact, terms

had been arranged; the announcement being left over to be made to the Committee later in the day. At the close of the proceedings, however, the Chairman made an important statement which rather modified the whole position. He informed Counsel for the Middlesbrough Corporation that, with regard to the Eston and Normanby districts, the Committee were satisfied that the Corporation had not made out a case for their inclusion; and it might be taken that the Committee would not grant the Order in respect of these districts. This, of course, at once negatived the arrangement which had been come to with at any rate one of the Gas Companies; but the Chairman intimated that the Committee would like to hear the other Company.

The position was left in a somewhat indeterminate position; and eventually it was decided to adjourn the Committee until to-day (Tuesday). The one thing made clear by the Committee was that, so far as Eston and Normanby are concerned, the promoters have not made out their case.

WATFORD ELECTRIC LIGHTING EXTENSION.

Gas Company's Opposition.

HOUSE OF COMMONS COMMITTEE.—Tuesday, July 15.

(*Before Sir* WILLIAM HOWELL DAVIES, *Chairman*, *Mr.* BLAIR, *Mr.* HAYDN JONES, *Mr.* STEPHEN WALSH.)

This Electric Lighting Provisional Order Confirmation Bill includes an extension to the electric lighting area of the Watford Corporation. It was opposed by the Watford Gas Company.

Counsel for the Order were Mr. VESEY KNOX, K.C., and Mr. TYLDESLEY JONES. Mr. CLODE, K.C., and Mr. A. M. PADDON appeared for the Watford Gas Company.

Mr. VESEY KNOX explained that this was an Order granted by the Board of Trade for extending the limits of the electric supply area of the Watford Corporation to include the district of Abbots Langley and some parts of the rural district of Watford. None of the local authorities concerned were opposing; the only opponent being the Watford Gas Company, who had power to supply gas in the portion of the Watford rural district which was being taken over, but not in Abbots Langley. The Gas Company opposed the present Order before the Board of Trade, but were over-ruled. An Electric Lighting Order was originally granted in 1897, and supply was commenced in 1899. Subsequently there had been one or two extensions of the borough boundaries, and the electric lighting area was made to coincide. In the year 1904, when certain extensions were added to the boundaries, the Gas Company succeeded in obtaining the insertion of the Northumberland clause. This was a most complete protection; and if the Company had any complaint as to the way the Corporation electrical undertaking had been carried on, they could have taken the matter to Court. This had not been done, however; and perhaps their opposition now was because the electricity undertaking was very much more successful than it had been in its early years. In 1910, the profit was £274; in 1911, £791; in 1912, £2122; and in 1913, £1112. The reduction in the profits in 1913 was due to a reduction in the price charged, as it was felt that the gross profit of 9 per cent. on the capital expenditure, which was made in 1912, was too much for a municipal undertaking to make. The undertaking was developing rapidly in all departments, and particularly in the power demand. A number of new industries had been attracted to the town by reason of the cheapness of the supply. Public lighting had been, perhaps, developed a little too early in Watford—he was prepared to make this admission. At a very early stage in the history of the undertaking, separate mains for public lighting were laid throughout the district; and to cover the capital charges as well as annual charges, the Council agreed to set aside for public lighting a fixed annual sum of about £4000, and at first this was a very heavy charge. This arrangement had now been abandoned, however, and the ordinary system of charging so much per 50-candle power lamp substituted. The charge was £2 17s. 6d. per annum; and the policy now was to keep this fixed charge while increasing the total quantity of lighting. This had been increased from 16,000-candle power to 72,000 candles. Under the circumstances, it was not surprising that a number of people in neighbouring districts were also anxious to have an electric supply. By section 6 of the Electric Lighting Act of 1909, the Council could supply in the outside districts with the consent of the Board of Trade; but a separate application had to be made for every consumer. In 1909, also, the Council obtained, in a Bill of their own, powers to supply over the border within a radius of 500 yards; but it was claimed that the General Act would enable the Council to go further afield than 500 yards, with the consent of the Board of Trade. The Gas Company disputed this, and made an allegation of a breach of a parliamentary bargain; but this was not so. As a matter of fact, one consumer was being supplied who was three miles away. The arrangement with the local authorities concerned was that in Abbots Langley the same prices should be charged as in Watford, as soon as 50 consumers were obtained; and in the rural district of Watford, the same prices would be charged at once. It was therefore inequitable that the Gas Company should be allowed to appear before the Committee in order to try and prevent the people in these outside districts having a supply of electricity. The present process of having to apply to the Board of Trade for permission to supply in each individual case was slow and cumbersome; and it was for this reason, coupled with the growing demand in the districts in question, that the Order had been promoted.

After evidence had been called, indicating that there are a number of people outside Watford who want a supply of electrical energy,

Mr. *W. F. Goodrich*, the Chairman of the Watford Electric Lighting Committee, gave evidence. He said that the amount of money which the undertaking had received from the rates in the early years of its existence had been paid back with the exception of £96, and that the undertaking was now a very prosperous one.

Mr. CLODE, in cross-examination, pointed out that the area of the Watford Council at present was only 3¾ square miles, whereas the district now proposed to be taken in was some 50 square miles. It would be 7 miles from the Council's generating station to the furthest point in the new area. The witness was unable to give any information on the details of the scheme, and contented himself by repeating that the Electricity Committee had been satisfied that it would be a commercially sound proposition; otherwise it would never have been brought before Parliament.

Counsel then went on to question witness with regard to the charge for public lighting, which represented a profit of 54 per cent. on the old basis and 40 per cent. on the present charge. It was to this that the Gas Company, as a ratepayer, objected; for it made the profits of the undertaking wholely fictitious. Similarly large quantities of current were supplied to the various departments of the Council; the total representing one-third of the output of the works. Again, the rating of the electricity undertaking, with a capital of £102,559, was only £271; while the Gas Company, with a capital of £135,000, were rated at £1420.

Mr. VESEY KNOX, for the Council, said the rating was on the basis of profits, and the rating of the electricity works had recently been increased to £600.

Mr. CLODE was proceeding to put further questions to witness on the general administration of the electricity undertaking when,

The CHAIRMAN remarked that the Committee did not wish to hear arguments as to whether gas or electricity should be used.

Mr. KNOX said that the Council had not overcharged the public services compared with the prices charged to private consumers using current for similar purposes; but if the Gas Company had any complaint, they had their remedy under the Northumberland clause. Having this remedy, he submitted the Gas Company were not entitled to go into these matters now.

Mr. CLODE said he was going to show that the provisions of the Northumberland clause had been entirely disregarded. After the Chairman's ruling, however, he would go away from the subject at once. He had not intended to show that electricity was worse than gas, but merely to point out that the price of electricity was unduly high, and the Council were now coming to Parliament to say what a successful undertaking they had, when in fact most of the profit was derived from the public services. Unless he could do this, a very valuable part of his case would be gone.

The CHAIRMAN said the Committee were generally agreed that this line of argument should not be pursued.

Mr. CLODE said he should, of course, bow to that ruling.

The CHAIRMAN then put it to witness that the Council were coming to Parliament for these powers, and the intention was, as was often the case, to exercise them as the demand arose.

Witness said that was so.

Mr. CLODE asked for the Engineer's report upon the scheme, with a view to seeing whether it showed a profit.

Mr. VESEY KNOX objected to this being given up on the ground that the report had not yet been before the Council.

Witness, however, said he had no objection.

Mr. CLODE, having received a copy of the report, said that it would be looked into by his electrical experts.

Wednesday, July 16.

When the Committee met this morning,

Mr. CLODE, on behalf of the Gas Company, said he would like to to make a statement with regard to the attitude of his clients. He had had an opportunity since last night of carefully considering the ruling which the Chairman had given; and his clients had come to the conclusion that, inasmuch as they would be precluded from going into the question of whether gas or electric lighting was better for Watford, also as to the overcharge for public lighting, and having regard to the Gas Company's remedy under the Northumberland clause, they could not usefully prolong their appearance before the Committee. He would therefore withdraw so far as this House was concerned.

Under the circumstances, only formal evidence was called on behalf of the promoters in support of the preamble, and the Order was sent forward for third reading.

Hoylake and West Kirby Gas and Water Company.

The report of the Directors and the accounts for the year ending June 30 (which will be submitted at the thirty-sixth ordinary general meeting of the Company) show that the balance at the credit of profit and loss, after payment of the dividends, and transfers to renewals and reserve funds, in respect of the year to June, 1912, is £2378, to which has to be added the net revenue for the past twelve months, £8472—making a total of £10,850. Deducting the interim dividend paid in January (£2600), there is available a sum of £8250. From this, the Board recommend the payment of the following dividends: 6 per cent. on the "A" gas original capital; 4½ per cent. on the "B" gas additional capital; 6 per cent. on the "A" water original capital; and 4½ per cent. on the "B" water additional capital. These will absorb £3899, and leave a balance of £4351. After transferring £300 to the water back-dividend reserve, £800 to the gas, and £250 to the water contingency and plant renewal fund, and adding £799 to the gas reserve fund, there is left £2202 to carry forward. The dividend scheme, together with the interim dividend paid in January, represents a total distribution, less income-tax, for the year of 10 and 7 per cent. on the "A" and "B" capitals respectively. The gas reserve fund will then stand at £3496. The Directors announce their intention of immediately paying a further dividend of 2½ per cent. towards the deficiency in maximum dividend on the "A" water capital, for the year ending June 30, 1883. The quantity of gas supplied last year to private consumers and the public lamps was 63,300,480 cubic feet. The price of gas during the period under review was 3s. 4d. per 1000 cubic feet, less varying discounts; while the charge to users of prepayment meters was 4s. 2d.

Newmarket Public Lighting Contract.—It was resolved at the last meeting of the Newmarket Urban District Council that the contract with the Gas Company for public lighting for ten years, from September, should be sealed.

LEGAL INTELLIGENCE.

HIGH-PRESSURE GAS-LAMP PATENT LITIGATION.

HIGH COURT OF JUSTICE.—CHANCERY DIVISION.
Tuesday, July 15.

(*Before Mr. Justice* ASTBURY.)

James Keith and Blackman Company, Limited, v. Tilley High-Pressure Gas Syndicate, Limited.

This was an action to restrain infringement of plaintiffs' letters patent No. 28,360 of Dec. 24, 1907. Defendants denied infringement, and further alleged that the patent was invalid.

Mr. A. J. WALTER, K.C., Mr. COLEFAX, K.C., and Mr. SINCLAIR appeared for the plaintiffs; Mr. T. TERRELL, K.C., and Mr. JAMES ROBERTS represented the defendants.

Mr. WALTER, in opening, said the plaintiffs were the registered owners of letters patent granted to James and George Keith for "Improvements in and relating to gas-lamps." It was alleged that the defendants had infringed, by importing and selling, gas-lamps made as described in the plaintiffs' specification. The specification was for improvements in and relating to gas-lamps, more particularly to those used for high-pressure gas lighting with inverted burners, and had for its primary object to provide a lamp having an improved form of heater in which a mixture of gas and air was heated as highly as possible. A further feature was for the formation of the nozzle connected to the heater which served to convey away as much of the heat as possible over the tip and transfer it to the heater. Another feature was the arrangement, inside the main body of the lamp, of a cylinder formed with air-inlets, and between which and the lamp body the exhaust gases were led. Under the invention the heater was made substantially in the form of a hollow disc made of aluminium, nickel, or other suitable metal which did not readily oxidize with heat. Various attempts had been made to deal with the problem of burning the flame downwards, as the tendency was for the hot flame to go backwards; and this patent solved the problem by warming the gas. The hotter the flame, the better the light; or, in other words, the nearer one approached to an explosive mixture the higher was the temperature of the flame. The moment one began to approach the explosive mixture, one was faced with a difficulty of firing-back. The plaintiffs' invention was to avoid this difficulty; and so successful had it been that lamps to the amount of over £150,000 had already been sold. The combination consisted of a heavy metallic nozzle, of the non-conducting external, and of the heater arranged in combination, as described in the specification; and these identical elements had been taken by the defendants. By use of this combination a light efficiency of 65-candle power was obtained for one cubic foot of gas per hour. The plaintiffs' title and the sale of the infringing article were admitted.

Mr. *Dugald Clerk* was called, and said he had carried out a number of experiments in connection with the appliances mentioned in the specification. The effect was to heat as highly as possible a mixture of gas and air in order to get a high illuminating power with a small consumption of gas. The nozzle took away the heat and carried it to the heater. The plaintiffs' invention produced the result of giving a high yield to the gas—in fact, the addition of the heater, *plus* the burner, gave an increased power of 66 per cent. The effect of removing the non-conducting ring was that the lamp fired-back. The improvements in the plaintiffs' specification were very important ones, and could not be described as minor. The effect of increasing the quantity of air with the gas was to increase the flame temperature. Having examined all the alleged anticipations, he did not find the combination claimed in the plaintiffs' patent. The invention was a useful one. There was nothing ambiguous or misleading in it; and, so far as he knew, the invention was new.

In cross-examination, witness said gas and air heating was well known, and old; so also was a thick metal nozzle. A heater with a central part to distribute the flow of gas was old.

Wednesday, July 16.

Witness, in further cross-examination this morning, said that, so far as the invention was concerned, it was applicable to low-pressure as well as to high-pressure lamps. High-pressure lamps with inverted burners were well known at the date of the plaintiffs' patent, and they were rapidly developing. Instead of getting 18-candle power, they now obtained a largely increased candle power for the same amount of gas. It was not desirable to have it heated as much as possible. The addition of 2 or 3 per cent. to the heater would not be material. The transfer of some heat from the tip of the nozzle to the heater was not immaterial—its main object was to prevent ignition in the nozzle. If one had a pure explosive mixture, one still might prevent firing-back. The velocity in the burner was fairly high; the pressure of the mixture was not at all comparable to the pressure of the gas. The rate of flow must not be too high, or else it would blow the mantle away from the nozzle. The checking of the flow in the tube did not reduce the amount of gas, but the amount of air. The more one checked, the more removed one was from an explosive mixture. The mantles used in high-pressure lamps were very thick, and had a close mesh; and the mantle acted as a check on the flow. Firing-back depended on the rate of propagation of the flame and the rapidity of flow. By means of a check one got less air and the same gas, and so removed it away from the region of an explosive mixture. It was not fair to compare a lamp with a mantle on and one with it off. If a lamp had no mantle on, there was less resistance to the flame. It was necessary to get an explosive mixture in the mantle. Supposing one had a tube a foot long, and a mixture of gas and air flowing down the tube, and somewhere near an explosive mixture, and the light was applied to the bottom, the flame would go up the tube very rapidly—it all depended on the rate of propagation of flame. Striking-back could be checked by increasing the richness of the mixture or the rate of flow. By over-heating the mixture, a more explosive compound was made. The use of non-conducting material was old; and putting a non-conducting ring close to the nozzle was also old. In non-pressure burners, the flame was different from that in pressure burners; the difference between the two being that in a low-pressure burner the flame licked round, while in a high-pressure burner the air did not come in—one had to rely on the primary air pure and simple, and the air had to be driven through the mantle.

Professor *Charles Boys* said he had studied plaintiffs' specification, and found the object was to make use of the concentration given by high-pressure gas, and to obtain, with the advantage due to concentration, the further advantage due to greater heating as far as possible, and, while doing this, to obtain a steady and reasonably silent efficient light. The manner in which the plaintiffs arrived at this was by heating the air, and also the air and gas in the heater. Attached to the heater was the heavy nozzle in thermo contact with it; and the tip was protected from overheating by the non-conducting mantle-ring. If the heavy nozzle was not connected to anything at all, it would in a short time get so hot that there would not be the cooling by the heater. The amount of heat actually added to the heater from the nozzle was about 3 per cent. If the nozzle was not connected to a ring cooler than itself, the nozzle would become red hot. The heat was conveyed away, and the tip was not allowed to get hot enough to fire the gas. It was of great importance to keep the nozzle cool. If the tip of the nozzle was red hot, then the stream of gas coming down on its inner face would be heated up above the other gas, and it would flare and strike up the inside, and the mischief would be done. He had made certain experiments, from which he found that each of the elements claimed was essential. The result of substituting a thin nozzle for a heavy one was that firing-back occurred in five minutes; while in the case of a thick nozzle with the metal ring omitted it fired-back in a quarter-of-an-hour. In the case of smaller lamps they did not fire-back automatically; but on testing the margin of safety, having got it up to the best light and all going well, the reduction of the flow of gas gave this result—that when the lamp was made with a thick nozzle and non-conducting ring, it could be turned to a lower state of velocity than it could with a thin nozzle or the non-conducting ring left out. The adoption of the plaintiffs' invention gave a less material advantage in the case of the smaller lamps. In the defendants' lamp, there were present the same three elements of combination; the only obvious difference being in the form of the heater. Having gone through all the prior publications, he had come to the conclusion that none of them contained the plaintiffs' entire combination. The plaintiffs had taken the heat from where it was not wanted, and put it where it was of some use.

In cross-examination, witness said there was nothing new in the heater, *quâ* heater, or heavy metal nozzle. The heater was mainly used as a mixing chamber. The idea of regeneration was a very old one; but the difficulty was to do it. Thick metal burners were also well known. If one did not have the three elements in combination, the two alone would fail. Defendants' heater was a smaller and less efficient one than the plaintiffs', though it was a good equalizer. The advantages to be found in the plaintiffs' specification were not to be found in that of the defendants. It was essential that the mantle-ring should be tight to the burner; but he did not know that it was necessary that it should be non-conducting. Such rings were well known at the date of the plaintiffs' specification.

Re-examined: The withdrawal of heat from the burner-tip was a very important matter. In the plaintiffs' case this went for what it was worth into the heater. The three elements indicated in plaintiffs' patent were all of importance in the combination.

Mr. *George Keith*, the Managing Director of the plaintiff Company, said he was acquainted at the date of the specification with the burners in actual use for high-pressure lamps. One was the Selas burner, and another was the Graetzin. The mantles were secured in both cases by metallic rings. He had never known of any nozzle for high-pressure lamps that was shielded by a non-conducting ring.

This closed the case for the plaintiffs.

Mr. TERRELL said, before calling his witnesses, he might shortly state that his case was that there was no subject-matter in the plaintiffs' specification, and that the invention put forward was one merely for the purpose of the case. The patent was bad for want of utility. In the defendants' lamp, the elements did not co-operate to do anything; and therefore they could not be said to infringe. In both cases the heat was taken from the tip—in the one case it was taken to the heater, and in the other to the air.

Mr. *James Swinburne* said that, in his opinion, the heat transferred to the heater was of no material importance. The heat could be regulated by altering other factors than by the nozzle. When inverted burners first came in, the nozzle was made of brass. It was found the nozzles burnt away, and now they were made of a refractory material. The object of keeping the tip of the nozzle cool was to prevent it being burnt away; but whether the nozzle was kept cool or not would not make any difference to firing-back, as the gas and air were driven through the nozzle with high velocity. Lowering the pressure might cause striking-back. By increasing the bore, the velocity in flow of gas and air was reduced, and firing-back was the result. If the heated nozzle was the cause of firing-back, then the mischief was in both specifications. Plaintiffs' invention was not limited to a high-pressure burner. The difference between high-pressure and low-pressure burners was that in one case the flame went through the mantle, while in the other some of the flame did not go through.

In cross-examination, witness said the higher the temperature obtained by combustion the better would be the radiation from a body heated in that gas. The more nearly the combined gases approached to the heating requisite for complete combustion the higher the temperature would be. It was desirable to approach as near as possible to an explosive mixture for an incandescent burner. In the case of a metallic burner not provided with some conducting part for the heat given to it, the flame burning at its mouth would become very hot; and if the tip got very hot, the flame began to creep up inside. If one had a metallic nozzle and provided a part to which the heat might

escape, this would drain the heat away from the metallic nozzle by the heat given to it by the flame burning at the mouth.

Thursday, July 17.

Witness, in re-examination, said there was nothing in the plaintiffs' specification to show what the thickness of the metallic nozzle should be. "Striking-back" meant that the interior of the tube was on fire instead of an unfired mixture reaching the mouth of the tube.

Professor *Vivian B. Lewes*, after giving an account of the introduction of incandescent mantles, said it was found that the shadow thrown by the lamp was a drawback, and various attempts were made to introduce an inverted burner; the first being by Kent in 1896, who was followed by Bernt and Sevenka and others. Inverted mantles first began to be used under pressure in 1905. After tracing the various steps taken to arrive at a perfect burner, witness said high-pressure burners might be looked upon as a device for burning a very large volume of air in a very small space. To compare two lamps properly it was absolutely necessary to use the same mantle, the same pressure, and the same gas consumption. No two mantles ever acted alike. In order to ascertain how far the thick metal burner tube increased the illuminating power of the lamp, a 1000-candle power Keith lamp was obtained and tested; gas equal to a pressure of 81 inches of water being used. The results obtained were: Illuminating power, 952 candles; gas consumed per hour, 15·93 cubic feet; efficiency, 59 7 candles per cubic foot. The same mantle was then fitted to the same burner-tube, which had been turned down in a lathe to about 1-18th of an inch in thickness; and the following results were obtained: Illuminating power, 968 candles; gas consumed per hour, 15·93 cubic feet; efficiency, 60·7 cubic feet. So that it was evident the thick burner nozzle was of no advantage from the point of view of maintaining a high illuminating power. A similar experiment was made with a Tilley lamp (the same mantle being used), and the following was the result: Illuminating power, 928 candles; gas consumed per hour, 17·11 cubic feet; efficiency, 54·2 cubic feet. The burner nozzle was then turned down, and the result was: Illuminating power, 1010 candles; gas consumed per hour, 17·11 cubic feet; efficiency, 59 cubic feet. So that in this case also the thin nozzle was an actual advantage; but it could not have been used economically, as it would quickly corrode and burn away.

Cross-examined: To a certain point it was an advantage that the burner-tip should not become too hot. With a heavy section burner-tip, the conductivity of the heat away from the tip would be better than with thin metal. If the tip got too hot, one might get local firing inside the tube; but whether it would run up depended upon the temperature above it. The higher the candle power, the fiercer the heat; and inside the mantle the temperature was exceedingly high. If the outside was protected by non-conducting material, the tip was protected from the burning away action of the gas. It was important in all these lamps to get a margin of safety, as it enabled one to have certain faults in burning and slight variation in pressure. Gas rich in hydrogen would strike-back quicker than gas not so rich. Selas and Greyson were the only two high-pressure burners in use before the plaintiffs'. But whether the mantles were supported by metal he could not say.

Mr. *George Helps* said that during the last ten years he had done a great deal of practical work in gas-burners, having devoted his attention to both the high and the low pressure systems. It was most difficult for anyone to state with certainty the cause of any specific striking-back—there were thousands of different causes. He did not think it was possible for a high-pressure lamp to strike-back owing to the tip of the nozzle getting hot. Heaters were used long before the date of plaintiffs' patent.

Cross-examined: Every lamp would light-back under some conditions. He could not assign a reason for this.

By the JUDGE: He had known Keith lamps to light-back; but he should say they lighted-back less than other lamps. To have a good burner it was essential to have a well-proportioned burner-tube, a well-proportioned air chamber and nozzle, a heater or expansion chamber, and a good metal, proportioned to the flame, suitably attached to the nozzle.

Mr. *F. C. Tilley* gave the result of an experiment which he had made that morning with a 1500-candle power Keith lamp. Using a heavy nozzle with a pressure of 81 inches, the gas consumption was 26·56 cubic feet per hour, angle of test 2°, candle power 1165, efficiency 43·9 cubic feet, time occupied three-quarters of an hour. With a thin nozzle, using the same mantle and the same pressure of 81 inches, the gas consumption was 26·26 cubic feet, angle of test 2°, illuminating power 1023 candles, efficiency 38·5 cubic feet, time of test three-quarters of an hour. The lamp did not fire-back.

Cross-examined: The gas was that supplied by the Gaslight and Coke Company. The lower candle power was due to the difference in the angle of test.

Mr. TERRELL then summed up the case on behalf of the defendants, contending that they had not infringed, and, next, that there was no substance in plaintiffs' claim. No one in the trade reading the specification would be aware that putting a certain combination of parts together would produce a certain result, and therefore there was no subject-matter entitling plaintiffs to relief. An inventor must tell one what he was going to do, and not leave the reader to guess what the result would be of combining certain things.

Friday, July 18.

Mr. WALTER having been heard in reply to-day, his Lordship reserved judgment.

The Judgment.

Monday, July 21.

His LORDSHIP, in giving judgment, said: The action was brought to restrain infringement of a patent for improvements in and relating to gas-lamps; and the matter in respect of which the claim was brought was high-pressure gas-lamps with inverted burners. The pressure of ordinary gas-mains was from 2 to 3½ inches of water. This mixture required a further supply of oxygen for the purpose named; and if the mixture was heated in its passage to the burner, its power was raised. Gas under pressure exceeding that in the main was used, and this enabled more air to be mixed with it. High-pressure gas had been used of from 8 to 18 inches, at which latter pressure the proportion of air and gas in the burner-tube was raised to about 4½ parts to one. This increased the incandescence, and therefore the lighting power of the mantle enabled lamps of a high candle power to be used. But precautions were necessary to prevent the burner becoming too hot, and heavy metallic nozzles and burners were used to reduce the heat, though these were well known at the date of the patent. Further, the mantle-rings claimed, which might be of non-conducting material or magnesia, were also well known. Of the eight claims in the specification, No. 1 was the only one as to which infringement was complained of; and that was inverted gas-lamps with a combination of gas and air heater connected with a burner-tube, a heavy metallic nozzle connected with the heater, and a mantle-ring. The defendants' lamp contained these several details, and the particular lamp referred to was that of a 300-candle power lamp. The defendants' heater was not constructed in the special manner described in the plaintiffs' specification, but was an ordinary heater such as was known before the date of the patent. The defence relied upon was invalidity and want of subject-matter. It was said that the plaintiffs had only taken old and well-known parts; that the only novelty was the nozzle in contact with the heater; that the so-called combination was not a real combination, but three several and independent portions of a lamp which were well known before; that the true meaning of the specification was the production of increased regeneration; that the plaintiffs had been compelled to rely upon the absence of firing-back; and that the patent was bad. As to the first point—that the combination did nothing but what heaters did before reliance had been placed on the specifications of Monneyrat, Wright and Darwin, and Lake—in Monneyrat's specification there was a heater connected with a burner-tube which, for the purpose of heating *per se*, did not differ from that described in plaintiffs' specification. In Wright and Darwin's, there was also a heater similarly connected; and the same remark applied to Lake's specification. With regard to the heavy nozzle, it was admitted that a nozzle of non-conducting material was old and well known for keeping the tip of the orifice cool. So far, therefore, as the three several parts were concerned, there was no doubt they were known prior to the date of plaintiffs' specification. He was of opinion that this was not a case of a mere addition to a well-known article, but it was the intermixture of combination producing a new and useful article. The fact that some parts might have been arrived at by the study of well-known articles having a different combination of parts was no evidence of non-invention or want of subject-matter. In each of the previous lamps in which one or more parts of plaintiffs' combination appeared, the total combination was entirely absent. In the Keith lamp of 1904, there was a heavy metallic nozzle; but that was a metallic connection or thermal connection with an outside portion of the lamp. The nozzle was not used in conjunction with any heater at all. In the Selas lamp, there was a heavy metallic nozzle in thermal contact with radiating arms for the purpose of conducting away the heat; but there was also a metallic ring surrounding the orifice of the nozzle protected on its outer side by some non-conducting material, and in the opening of the nozzle there was wire gauze for the purpose of preventing lighting-back. In the Wright and Darwin lamp, there was a heater or mixing-chamber; but that was employed in conjunction with a long non-conducting nozzle or burner which would be perfectly operative in the case of a low-pressure mixture, but which in a high-pressure lamp would heat the temperature and would be unable to convey the heat to some other part of the structure, and thus the inflammable mixture would be lighted. Lake's lamp was also a low-pressure one, and the same result would occur. In Monneyrat's lamp, which was a low-pressure one, the heater which was claimed in connection with the gas-tube was used in conjunction with a burner pointing upwards, and not inverted; and the problem of an inverted lamp for high-pressure which was solved by plaintiffs' patent, did not arise at all. On the evidence, he was satisfied that plaintiffs' lamp, having the combination referred to, was, in fact, a new and commercial article. He found also that plaintiffs' combination would work at low pressure, although it was more particularly designed for high-pressure lighting. The efficiency of the lamp was not in contest. He came to the conclusion that plaintiffs' patent was valid—that claim 1 had been infringed—and therefore he must grant an injunction, with costs, and an inquiry as to damages. There would also be a certificate as to breaches, and an order for delivery-up or destruction of the infringing parts.

On the application of defendants' Counsel, a stay as to the inquiry and for delivery-up was granted pending an appeal.

ACCIDENT TO A MOTOR LORRY.

A Subsidence Case.

At the Westminster County Court, on Monday of last week, before his Honour Judge Woodfall, the Metropolitan Water Board and the Gaslight and Coke Company were sued by the Associated Coal Consumers, Limited, for damage arising out of an accident through plaintiffs' motor-lorry sinking into a portion of road which had been taken up after the Water Board had repaired a pipe.

Lord TIVERTON appeared for the plaintiffs. Mr. VAUGHAN WILLIAMS represented the Gaslight and Coke Company, and Mr. J. W. B. BROWN the Metropolitan Water Board.

Lord TIVERTON, in opening, said the case arose out of a chapter of accidents. On Nov. 13, Messrs. Brydon (a firm of engineers, at Glendower Place, Kensington) discovered a leakage of water in their cellar. They communicated with the Water Board, who had control of the water under the street; and the Gaslight and Coke Company also owned a gas-pipe close to the Board's pipe. The Board sent down some men, who opened the road, found the leak, and apparently remedied it. Having discovered the leak, they filled up the road to a certain extent—as far

as they ought to have done—and gave notice to the local authority, who completed the work. Messrs. Brydon thought the Board had done their work properly; but as on the following day there did not appear to be a diminution in the water in the cellar, they believed the ground must have been so saturated with water by the original leak that it was gradually draining out. Two days later, however, they noticed that, instead of the water getting less, it was increasing, whereupon, on the 20th of the month, they again notified the Board, who sent an official down. After making an inspection, he said the leak would be repaired. Unfortunately, before the next day arrived the accident had happened. Plaintiffs had a motor-lorry; and it was passing over the piece of road which had been opened, when a back wheel sank right down up to the axle, because, it was assumed, the leak had washed away the subsoil. Just at the spot there happened to be one of the Gas Company's pipes; and when the wheel went down, the gas-pipe was broken. The lorry had a boiler; and with a flash, the escaping gas caught fire. The flames reached 30 to 40 feet in height; and two hours elapsed before they were extinguished. A considerable amount of injury was caused to the adjoining property; and the lorry was damaged to the extent of £97 odd, for which plaintiffs were suing.

After evidence by the driver and other witnesses had been given,

Mr. WILLIAMS, for the Gaslight and Coke Company, submitted that there had been no evidence given against his clients. There was no evidence of any leak in their pipes before the accident. There had been no smell of gas; and he submitted there was no case of negligence.

His HONOUR: There is the pipe for which you are responsible. The pipe breaks, and does the damage.

Mr. WILLIAMS said the plaintiffs had admitted they had broken the gas-pipe. Their lorry went down suddenly into the hole, and from that moment there was a smell of gas; and, because of this, he submitted he had no case to answer.

His HONOUR said he agreed there was no evidence against the Gas Company.

Lord TIVERTON said the evidence showed that the Company had a pipe there which they had to maintain. The gas leak caught fire, and burnt the lorry.

His HONOUR again interposed that he did not think Mr. Williams had a case to answer. He would, however, hear the case.

Mr. WILLIAMS said his clients were not brought into the case till six months after the accident.

MR. BROWN, in opening the case for the Metropolitan Water Board, said there was no evidence to show that there was a leak in the main or in the service-pipe. If it was in the service-pipe, he submitted the Water Board were not responsible for the maintenance of service-pipes, because the occupier had power to open the roadway and repair the pipe. In the present case, it was perfectly true that they opened the roadway; and the plumber who contracted for the work mended a communication pipe. His evidence was that the pipe was repaired thoroughly. One of the witnesses had said that water came into the cellar a second time; but it was not till five days afterwards that he sent a postcard to the Board calling their attention to the fact. It was the duty of the man to tell the owner of the premises about the leak. He would call evidence to show that the leak which was repaired on Nov. 21 was in a part of the pipe where it entered the cellar, and quite a distinct and different place from where it was on the first occasion. It was the practice in London, where the Board had power to open roads to effect repairs, to give notice to the local authority; and in most cases the local authority took upon themselves the duty of re-instating the road. In this instance, notice was given to the local authority; and when this was done, he submitted, the duty of the Board was discharged, and they were not responsible for the accident.

Evidence was then given by the plumber who mended the pipe, and also by officials of the Board.

His HONOUR afterwards told Mr. Williams his submission that there was no case against the Gaslight and Coke Company was a sound one; and they would be discharged from the action, with costs.

Mr. BROWN again addressed the Court, contending that the Water Board were not liable for the accident. It was a case where the re-instatement of the road devolved upon the local authority. He admitted if the accident had happened before the Council had had the opportunity of re-instating, the Board would have been liable, because they would have left something which was dangerous. The evidence was that there was no defect in the water-pipe; and the plumbers had said that the part of the pipe which was broken on Nov. 14 was effectively repaired. The second defect in the pipe, he contended, they were not responsible for, because it was in the wall of the mansions itself. There was no evidence whatever of negligence.

Lord TIVERTON said it was quite possible that the ground after the leak had been repaired was in such a sodden condition that it was a trap. The Board had a perfect right to fill in these trenches; and the Borough Council also had a right to take up the road and put it down again. But this did not excuse the Board putting the earth back again carelessly. No one had been called by the Water Board to diagnose where the leaks were. If the Board set traps for other people, they had to pay for them. There was evidence to show that where the accident happened the ground was flooded with water, because the driver had said when he secured a jack to get the lorry out, the ground was too sloppy and wet. It was the duty of the Board to be most careful to make the ground which they had opened so that a vehicle of this sort could stand on it without sinking in; and he submitted the Board had not discharged the duty which was incumbent upon them.

His HONOUR said he would give his decision later.

The Bayswater Sewer Fatality.—In connection with the sewer fatality at Bayswater last April, the Kensington Borough Council report that solicitors have claimed compensation, under the Workmen's Compensation Act, on behalf of Mrs. Parry, the widow of the sewerman who was killed. The Council state that the minimum amount of compensation under the Act is £234, and that this should be paid. The General Purposes Committee of the Council report that "the question as to the liability of the Gaslight and Coke Company to reimburse the Council the expense which they have incurred in connection with this sewer fatality is at the present time under our consideration, and we shall report thereon at a later date."

INJURY CAUSED BY AN UNLIGHTED TRUCK.

Action against the Tottenham and Edmonton Gas Company.

At the Edmonton County Court last Friday, before his Honour Judge WHEELER, K.C., and a Jury, the Tottenham and Edmonton Gas Company were sued by Alfred Mockridge, a sheet-metal worker in the employ of the Lamp Manufacturing Company, Limited, for damages for injuries sustained either by the negligence of the Gas Company's servants, or by the creation by such servants of a nuisance on a public highway.

Mr. WOODCOCK appeared for the plaintiff; Mr. SCARLETT represented the Company.

Mr. WOODCOCK, in opening the case, said that at about 5.30 p.m. on the 27th of December last the plaintiff was on his way home; and in crossing Woodside Gardens he walked into one of the Company's hand trucks, which was standing by the side of the kerb unlighted and unattended. He struck the barrow with his chest; and was knocked backwards, sustaining a fracture of the ankle, and had since been unable to follow his occupation, at which he earned, on an average, £3 5s. per week. The road, it was submitted, was badly lighted—a public lamp near the spot being out, and the shop lamps at each corner of the road being unlighted. The street-lamps were lighted automatically, and it was no uncommon thing for them to be out, especially on windy nights, such as was the one in question. The plaintiff was taken to the local hospital, and was treated there.

Plaintiff, who is forty-nine years of age, gave evidence in support of his Counsel's statement, and added that after the accident he was unable to get up. He called for help, and two men came to his assistance. He crossed the road at about three o'clock in the afternoon, and he observed the truck there then. He was anxious to go back to work as soon as possible.

In cross-examination, he denied that a 600-candle power high-pressure lamp outside a cycle shop at the corner of the road was alight. On going out at three o'clock he met a friend, and they went for a walk, in the course of which they had some drink. He was on his way home when the accident happened; but he denied that he showed any signs of drinking. He advertised to find out who assisted him; and one man called on him the day the advertisement appeared.

Maurice M'Carthy, the man who replied to the advertisement, said he heard a cry for help, and ran to the spot. The plaintiff had then been assisted up by another man, and was about 1½ or 2 yards from the truck. Witness did not notice the lighting of the road.

John Macpherson said he went with the plaintiff for a walk in the afternoon of Dec. 27, and the plaintiff was not intoxicated.

Albert Hooker, who removed the plaintiff to the hospital, declared that he was sober, and said he himself had noticed that the road was not sufficiently lighted.

Two other witnesses deposed that there was no light at the spot.

Dr. *Pennant*, House Surgeon at the Tottenham Hospital, said that the plaintiff had a Potts fracture and dislocation of right ankle, which caused flat-foot and stiffness. It was very rarely there was recovery from flat-foot. Witness attended plaintiff up till the end of March.

Dr. *A. S. Wainwright* said the plaintiff had been under his care since that date. He could not stand on his toes, and when he walked any distance he got very tired. Witness thought plaintiff would always be lame, but was of opinion that he might do four hours' work a day now. The injury was a serious one.

Mr. SCARLETT, on behalf of the Company, contended that there was no evidence to support the plaintiff's story as to how the accident occurred, and suggested that he had been keeping Christmas. It was absurd, he said, to say that there should be a light on these trucks, because if so were they to have lights on street bins, pillar-boxes, and milk and bakers' barrows? Furniture vans must stand in the street for hours; and if it was going to be held that it was negligence to leave these and other trade vehicles there, business could not be carried on. This truck was an implement of trade, as it was necessary for the carrying-on of the Company's business; and it could not be taken into a house or left on the pavement. He should prove that there were lamps which threw a strong light on the spot; and if it were held that there was negligence on the part of the Company, he should ask the Jury also to hold that there was contributory negligence on the part of plaintiff in walking into the truck. People who used the streets must do so with their eyes open, and must look where they were going.

Dr. *Craigie Mondy* stated that he saw the plaintiff at 6.30 p.m. on Dec. 27, and formed the opinion that he had been having something to drink. Witness advised his removal to the hospital. He was acquainted with the locality, and knew that the high-pressure lamp at the corner, and another one in front of the shop, threw a strong light. Witness had made an examination of the plaintiff that day, and he did not think there was anything to prevent him going to work. He might have been doing something for the last three or four weeks.

In cross-examination, witness said he did not care to swear that the plaintiff was intoxicated on the day of the accident; but he was of opinion that he was not so much under the influence of drink when he saw him as he had been, because a shock such as he received had the effect of making a man more sober.

William Fenn, an employee of the Company, said he went out with the truck, on which there were a vice and a nine-rung ladder. He returned to the truck at six o'clock, and did not notice anything unusual. The light was in the road.

Replying to Mr. WOODCOCK, witness said the truck was standing at the spot from 10.45 a.m. The high-pressure lamp at the cycle shop was burning, and there was plenty of light thrown on the truck.

Mrs. *Suter*, wife of the occupier of the cycle shop, said that the high-pressure lamp was automatically lighted, and at the time of the year when the accident happened was turned on at about four o'clock. She had never known it to fail. There was also a 450-candle power light outside the shop window, and the shop was open till ten o'clock on the night of the 27th of December.

Employees of the Company were also called to prove that the high-

pressure lamp and the street-lamp were alight at the time of the accident.

His Honour, in summing up, said that nothing must be put in the highway unless there was sanction for it. A tree or a lamp-post could not be put there without the authority of an Act of Parliament or a bye-law under the municipal corporation. If a temporary obstruction were put on the highway, it must be so placed that the public were not in danger. He was struck with the fact that the truck in the present case was standing in the road from eleven in the morning until seven at night. It was most remarkable. He held that the Jury were bound to find that an accident did, in fact, happen; and he did not see that the plaintiff was guilty of any contributory negligence. The truck was placed in the road at the Company's peril. There was a controversy as to whether the road was lighted. As business men, the Jury knew what automatic lighting was. There was a considerable percentage of lamps that did not light.

The Jury returned a verdict in favour of the plaintiff for £75; and judgment for this amount, with costs, was entered.

Skegness District Council and Gas Supply.

Parliamentary action is contemplated by the Skegness Urban District Council with the view of obtaining statutory powers in relation to gas supply and acquiring the rights of the existing Company. Recent strained relations between the Company and those responsible for local government arrangements at the popular Lincolnshire resort, had apparently rendered some such action inevitable; and though the Company have not shown any unwillingness to meet demands which could be regarded as reasonable, conflicting views upon many points have proved to be of an irreconcilable character, with the result that notices have now been issued for a special meeting of the Council to be held early in the coming month for the purpose of considering a resolution authorizing them to apply next session for an Act vesting in them the authority in regard to the district supply, and also power to purchase the undertaking of the Company.

Bahia Blanca Gas Company, Limited.

The report to be submitted at the meeting of the Company on Thursday states that, owing chiefly to the higher cost of coal and freight, the working for the year ended Dec. 31 last has resulted in a loss of £1529. As the amount brought forward from the previous year was £1152, there is a net debit balance of £377. The total receipts increased by £3638; but the expenditure shows a rise of £6479. The working was very adversely affected by the consequences of strikes during the year; the extra cost of coal and freight resulting therefrom amounting to £3562. Carbonizing wages and labour generally also cost more. Sales of gas brought in an extra £1663, residuals £1446, and sundry receipts £529; and had the year been a normal one with respect to manufacturing costs, this increase would have enabled a satisfactory improvement to be shown. During the first half of the year, gas sold for lighting purposes showed a decrease month by month, due to the bad state of business in the town; but the improvement during the second half enabled this to be recovered, and the year closed with an increase of 314,000 cubic feet. Gas sold for heating, cooking, and power also experienced a reduced output during the first half year; but the later conditions enabled an increase for the year to be shown of 3,972,000 cubic feet. Gas sold for public lighting remained about the same. The total gas sales during the year were 43,606,000 cubic feet—an increase of 4,268,000 feet over 1911. The crisis through which the city of Bahia Blanca has lately passed has been exceptional; and its effects have been widespread and severely felt. With more reasonable prices ruling for coal and freight, and the continuance of improved conditions in the town, it is anticipated the Company will be able to show a distinct improvement in the future.

Price of Coke at Oldham.—In view of the general lowering of the prices of coke by Lancashire gas undertakings, the Gas Committee of the Oldham Corporation at their meeting last week decided to reduce the price from 13s. 4d. to 10s. per ton. It was stated that there was an accumulation of coke at the works.

Price of Gas at Congleton.—It was reported to the Gas Committee of the Congleton Corporation, at a meeting last week, by the Gas Manager (Mr. J. T. Broughton) that he had prepared a report as to the cost of making gas at their works; and he recommended that the price of gas for power purposes should not be increased. Mr. Palmer remarked that it was always being pointed out that the power user was an enormous consumer, whereas they heard very little of the other consumers. Mr. Lawton said he thought the price of gas taken for power should be raised. They had increased the price of coke; and he failed to see why they should not do the same with gas used for power, as one of the largest consumers was not a ratepayer at all. He moved, and it was agreed, that the Manager be instructed to obtain particulars as to the charges for gas for purposes from other boroughs similar in size to Congleton.

Colne Valley Water Company.—At the half-yearly general meeting of this Company on the 1st prox., the Directors will report that in the six months ended the 30th of June the sum expended on capital account amounted to £9059, and comprised payments on account of the several contracts for the permanent establishment of the Eastbury works, the laying of a new main to Shenley, and general main extensions for affording supplies to new properties. To provide for the increasing demand, and to be prepared in times of maximum consumption, a new softening reservoir has been constructed; the work being carried out by Messrs. Docwra and Son. The profit in respect of the revenue account amounted to £16,997. The balance of the dividend and interest account, after paying the interest on debenture and preference stocks and transferring £1500 to the contingency fund account, is £21,098. The Directors recommend the payment of the full statutory dividends at the rate of 10 and 7 per cent. per annum on the several classes of ordinary stocks, and, in addition, a payment of 1 per cent. actual on account of back-dividends on the "A," "B," and "C" stocks; leaving £7220 to be carried forward.

MISCELLANEOUS NEWS.

SULPHATE OF AMMONIA COMMITTEE.

Sixteenth Annual Report.

The following are the principal portions of the report of the Sulphate of Ammonia Committee for the twelve months ended June 30 last. It bears the signature of the Chairman (Mr. Thomas Milne), and was submitted at the annual meeting of the Association last Friday.

The Committee report with deep regret the death of Mr. John Hunter, which took place in April. Mr. Hunter had been associated with the Sulphate of Ammonia Committee since its formation, and was always a powerful and consistent advocate of sulphate of ammonia, and was very widely known among agriculturists. Mr. John W. Tayleur, B.Sc. (Lond.), F.C.S., has been appointed Superintendent of the Committee's experimental plot work, and lecturer on agricultural matters.

Lectures were delivered as usual as opportunities could be found. Farmers attend these lectures fairly well, and take a great interest in the discussions which follow. This is a useful way of disseminating correct information as to the value of proper manuring.

During the past season, 73 agricultural competitions for the Committee's prizes were completed as under: England, 46; Scotland, 18; Ireland, 6; Wales, 3.

Below is given a selection of the highest weights per acre in the various classes obtained by the use of sulphate of ammonia in conjunction with phosphates, potash, and farmyard manure.

	Tons.	Cwt.
Mangels.		
England—		
Princes Risborough Agricultural Association	59	2
Chiltern Hills Agricultural Association	57	10
Ireland—		
Kilkenny Agricultural Society	68	13
Killyleagh, Killinchy, &c., Farming Society	68	0
Wales—		
Llantwit Major Fat Stock Show	55	0
West Glamorgan Farmers' Association	30	17
Swedes.		
England—		
Staffordshire Agricultural Society	39	2
South Tyne Agricultural Society	38	6
Scotland—		
Western District of Fife Agricultural Society	58	6
Ballingry and Auchterderran Agricultural Society	48	3
Ireland—		
Forth Farmers' Association	43	8
Tullow Agricultural Association	40	0
Wales—		
Llantwit Major Fat Stock Show	32	0
Yellow Turnips.		
Scotland—		
Western District of Fife Agricultural Society	50	12
West Lothian Agricultural Society	43	4
Potatoes.		
England—		
Chertsey Agricultural Association	16	15
Middlesex Agricultural and Market Garden Society	15	17
Scotland—		
Perth Agricultural Society	12	7
" " "	12	6
Cabbage.		
England—		
Midland Ploughing Association	58	0

It was generally remarked by the Judges that, despite the heaviness of the crops, the composition and texture were good; this being due to the sustained flow of plant food provided by the sulphate of ammonia during the growing season.

The small area plot work commenced in 1910 has been continued. The plots laid down in 1913 are as under:

In England	1969	under 55	supervisors.
" Wales	309	" 9	"
" Ireland	192	" 1	"
" Isle of Man	63	" 1	"
	2533	66	

In consequence of the death of Mr. Hunter, who was to have carried out the arrangement of the experimental work this year in Scotland, no experimental plots have been laid down there; but proper provision shall be made for this another year. Of the total number of 2924 plots established in 1912, 2740 were carried out successfully; and in the great majority of these the advantages of complete dressings of artificial manures were amply demonstrated—the addition of sulphate of ammonia to the phosphatic and potassic manures being indispensable. The results of the 1911 plot work were printed and issued last autumn, and those for 1912 are in the printer's hands.

The sugar beet experiments laid down in Norfolk in 1912 were satisfactory, despite the cold and wet summer being unfavourable to the sugar beet crop. In all, 125 acres were dressed with various combinations of superphosphate, sulphate of potash, sulphate of ammonia, and, in some cases, salt and muriate of potash. The heaviest crop of washed roots obtained was 15 tons 4 cwt. per acre; yielding 18·2 per cent. of sugar. This crop was grown with a dressing of 2 cwt. of superphosphate, 1½ cwt. of sulphate of potash, and 1½ cwt. of sulphate of ammonia, costing approximately £2 11s. per acre. The highest sugar content obtained was 19·2 per cent. with a crop of 13 tons 2 cwt. per acre. This was obtained at a cost of £2 4s. 6d. per acre for artificials, which consisted of 5 cwt. of superphosphate, 1½ cwt. of muriate of potash, and 130 lbs. of sulphate of ammonia. The weight and sugar content, as a whole, compare favourably with the Continental averages.

The experiments are being continued this season in the same districts

on a somewhat smaller scale, in order to further test the efficiency of those dressings of artificials which gave the best results last year. In all, 36 acres are being dealt with. Mr. Tayleur has inspected all the sugar beet centres, and has also visited over 36 per cent. of the plot supervisors, in order that the Committee may be satisfied that the work is being properly done. For this purpose the Committee have provided a 10 to 12 H.P. two-seater motor-car. It was otherwise found to be impossible to visit quickly a large number of scattered experiments.

Joint overseas propaganda has been continued on similar lines as heretofore, under the direction of the German Sulphate of Ammonia Syndicate, who, with their large organization, are able to carry on the work in various Continental countries, such as Denmark, Holland, Italy, Sweden, Switzerland, &c., to the greatest possible advantage. Additional foreign propaganda has been undertaken in British India, with a view to encouraging the use of sulphate of ammonia in tea and sugar cane cultivation, as these two crops, and especially the latter, offer very great possibilities for the employment of sulphate of ammonia. The Indian Government are encouraging the cultivation of sugar cane to make up for the loss involved in the large reduction of indigo culture.

A new pamphlet entitled "Artificial Manures for the Farm, Small Holding, and Garden," containing revised and simplified recipes for practically all field and garden crops, and instructions for use, was issued in the spring, and an edition of 50,000 copies was quickly disposed of.

During the past year, 14 new subscribers have been secured:

	Producing in Terms of Sulphate of Ammonia.
7 coal, coke, and iron firms	8500 tons
7 gas undertakings, &c.	700 ,,
	9200 tons.

As the number of non-subscribing makers is reduced, it becomes increasingly difficult to get them to join us by direct application from London. The Executive Committee therefore again appeal to members to use their influence with neighbouring makers to induce them to help this Association in its most necessary work.

As the National Gas Exhibition which opens in London in October next will doubtless be visited by a very large number of gas engineers and managers from all parts of the British Isles, also from many Continental countries, as well as from the United States, the Committee consider it will be a very favourable opportunity for holding another international meeting of sulphate of ammonia makers. It is proposed to convene this meeting between Oct. 20 and 25 to synchronize with the special meetings of the British Commercial Gas Association fixed for these dates.

RE-INSTALLATION OF THE ILKESTON GASHOLDER.

Construction of a Brick and Puddle Tank.

Within the past week, the first section of the works in connection with the re-installation of the spiral-guided holder which was involved in last year's disastrous experience at the Ilkeston Corporation Gas-Works has been completed by the construction of the necessary brick and puddle tank. It is now hoped that, given favourable conditions, the whole of the operations above ground will be finished by October, and that in the following month an indispensable adjunct to the town's supply will again be rendered available. Amid the many stormy controversies to which the accident of January, 1912, with its consequent loss of life, gave rise, the Corporation have remained faithful to the original type of holder selected. If there had been any doubt about the matter, the exhaustive inquiry held under the authority of the Home Secretary by Mr. A. G. Drury, M.Inst.C.E., one of the Engineering Inspectors of the Local Government Board, when the spiral system may, in a sense, be said to have been upon its trial, made it abundantly clear that there was no inherent defect in the holder itself, but that the whole cause of the mischief was the unfortunate substitution of an above-ground steel tank for the brick and puddle one included in the original specifications. For this misguided policy—the outcome of mistaken notions upon the score of economy—the Corporation have had to pay dearly; but, whatever the waverings may have been in other directions, it says something for the consistency of the responsible local authorities that, unaffected by any scare to which the earlier experience may have given rise, they have pinned their faith to the suitability and entirely reliable character of a gasholder of this description—a conclusion towards which they were encouraged, if this were necessary apart from general experience, by the examples to be found close to their own doors, in the neighbouring townships of Long Eaton and Langley Mill. The efficiency of the contractors' work in regard to the holder, as originally installed, was demonstrated by the circumstance that after its collapse, consequent upon the fracture of the tank, only one side was found to have been "dinged," at a point at which it came into contact with the ground; the bottom curb being also bent beneath. Otherwise, for all practical purposes the holder was unimpaired—the soundness of the materials as well as of the workmanship having thus been established at most essential points.

It will be recalled that the factor of safety allowed in the tank plates formed the all-important matter of consideration in the later stages of the Government inquiry, when the opinion was forthcoming, from one of the best-known experts, that it was desirable that a higher factor than 4, as in this instance was given, should be allowed in a tank in which certain of the stresses are somewhat difficult to calculate; the reasonable ground, as it was pointed out, being that it is advantageous to allow a more generous factor of safety in the case of a spiral-guided holder, inasmuch as it was difficult to calculate what stress might be thrown on the rim of the steel tank. But, with all these considerations, which are of extreme interest on the technical score, the Ilkeston Gas Committee have wisely enough seen no reason to further concern themselves. The adoption of the brick and puddle design, which if it had been carried out as originally planned might have obviated a protracted and costly experience, has safeguarded the matter now against all ordinary liability of danger, even in a district where subsidences through colliery workings are an ever-potential cause of trouble.

While, necessarily, the tank is entirely new, there will be no variation in regard to the holder itself, which is to be reinstated exactly upon the original lines; the substitution of a few plates only being rendered necessary to take the place of those damaged. There will be two lifts, the top one being 108 ft. diameter and 25 ft. 6 in. deep, and the bottom lift 110 ft. 6 in. diameter and 25 ft. 6 in. deep; the capacity of the holder being 453,000 cubic feet, and of the tank about 1,250,000 gallons. Messrs. C. & W. Walker, of Donnington, the makers, whose original contract for the complete work was £5086, have naturally been entrusted with the reconstruction of the holder. The work is now being carried out with all reasonable speed—a fresh chapter in the history of the undertaking having been entered upon under the new managerial *régime*, represented by Mr. J. Exton Holt.

ELECTRIC LIGHTING IN BERMONDSEY.

The Financial Position of the Undertaking.

The Bermondsey Borough Council last Tuesday considered the accounts of the electricity undertaking for the past financial year, which showed that the profit was only £79 on a capital of £181,000, The Finance Committee, in their report, which was noticed in the "JOURNAL" a fortnight ago (p. 132), commented on these figures.

Alderman STOREY, Chairman of the Finance Committee, said it seemed strange that the Council should be the most profitable customer to the electricity undertaking, and it was disappointing to find that on their business with the Council they should make a profit of £900, which dwindled down to £79 owing to their loss with private consumers. In its early history, the undertaking had been subsidized out of the rates; and he hoped this would not occur again. He was sorry there was to be no reduction on the charge for street lighting.

Mr. J. FOGDEN, the Chairman of the Electricity Committee, remarked that the undertaking had paid its way, though they had to contend with the dock and coal strikes.

Alderman STICKLAND maintained that the accounts damned the undertaking. The more they increased their capital charge the smaller was the profit; and loss of profit meant an increase in the cost of street lighting. He held that gas for this purpose was much cheaper and better than electricity; and he pointed out that both the City of London and Westminster had substitnted the former for the latter because it was more economical.

Mr. F. E EDDIS said before long there would be a loss on the concern which would have to be met out of the rates. On last year's working, there was an actual deficit of more than £4000, if they took away what was spent on the public service. Half of the streets were lighted by electricity, and the other half by gas; but if all were lighted by gas they would save over £2000 a year.

The Council adopted the accounts and estimates; but with regard to the Finance Committee's report they decided to proceed to the next business.

BRISTOL ELECTRICITY UNDERTAKING.

Free Lighting and a Comparison with Belfast.

The local Ratepayers' Association infused a considerable amount of life into the proceedings at a Local Government Board inquiry which was held at Bristol last Tuesday. The occasion was an application by the Corporation for sanction to borrow £25,000 for the purposes of the electrical undertaking; and the Inspector was Mr. H. R. Hooper. It was explained that £18,000 was required for mains, £2500 for sub-stations, and £4500 for house-services; these being the estimated requirements for three years from August last. Mr. J. W. Lane (the Hon. Secretary of the Ratepayers' Association) said that it would be interesting to know for what particular mains the application was made. The Electricity Committee had offered current for lighting purposes for 1100 public lamps free of charge; and he inquired if any portion of the sum needed was for carrying out this intention. The Electrical Engineer (Mr. H. F. Proctor) replied that no portion of the present application was in respect of equipping the incandescent lamps referred to. Mr. Lane asked a number of other questions, and then made the following statement on behalf of his Association, giving their reasons for opposing the application.

We claim that the Bristol electrical undertaking is most extravagantly managed and capitalized. We claim that the cost of administration in comparison with the output is excessive. We claim also that the output of electricity is not up to the standard of quantity which such a large invested capital demands. On a recent statement by the Chairman, we claim that the Electrical Committee already possess machinery capable of working the Bristol tramways twice over, if required. At a Barton Hill meeting, Mr. Pearson, in reply to a question, said: "We have at present two large machines, either of which is prepared to drive the Bristol tramways to-morrow, if required." That in further proof of this, the Committee are proposing to supply 1100 street-lamps with lighting current free of charge. These two circumstances show that the machinery on hand is far in excess of present requirements. We ask that the adoption of such an unbusiness-like proposal may be prevented, as calculated to further confuse the accounts of the undertaking, and to interfere with the issue of a true statement of account, showing the quantity of current generated, its exact value, as well as the correct revenue derived therefrom. We claim that one Committee of the Corporation have no right to do work for, or supply goods or commodities to, another Committee, or even to the citizens direct, without making and showing in the accounts a fair commercial charge for the accommodation. We also claim that, while the Electricity Committee are charging the ratepayers an extortionate price for arc street lighting, they are not justified in giving away current free of charge. At a formal inquiry, presided over by yourself (Mr. Hooper), the Electrical

Engineer put down the cost of arc lamps at £9 each per annum. We are to-day being charged equivalent to £14 5s. per lamp. This, we claim, shows an excessive profit, and should be reduced by at least £2000 per annum. We claim that before the Committee are empowered to give current away, they should be compelled to repay the £13,000 borrowed from the borough fund. We beg to put in the following statistics, taken from the balance-sheets of the Corporations of Belfast and Bristol for the year ending March, 1912. The short notice given of this inquiry has prevented us comparing similar accounts for 1913.

	Belfast (Started 1895).	Bristol (Started 1893).
Population	391,000 ..	380,000
Amount spent on land and buildings	£11,000 ..	£17,400
Amount spent on machinery	£13,700 ..	£316,000
Amount spent on mains	£174,000 ..	£276,000
Total amount expended	£383,000 ..	*£857,000
Total units accounted for	16,000,000 ..	13,700,000
Wages	£8100 ..	£13,500
	£500 per Million Units.	£1000 per Million Units.
Paid in relief of rates	£5000 ..	*Nil*

* With a capital of £857,000, and at the rate of the Belfast output, the total number of units for Bristol should be approximately 36,000,000, which shows we are not getting value for our money.

These comparisons are designed to demonstrate the insignificant results obtained by the Bristol Electrical Committee with the large sum entrusted to their care, and the immense leeway which has to be made up before the Bristol electrical concern can claim to be in the same favourable commercial and financial position as Belfast. In conclusion, we beg that the present application may be refused. On general grounds, we urge that the time has arrived when the continuous borrowings of municipalities must be checked. On local grounds, we ask it for the reasons of the present enormous indebtedness of our city and the very heavy rates with which we are burdened. The ratepayers of Bristol have pledged their credit to this Committee to the extent of nearly a million pounds; and it has been shown by comparison that they have not made the best possible use of it. Before any more money is granted to the Committee, we respectfully ask that the whole of the electricity undertaking may be submitted to an independent Government valuer for valuation; that the output of electricity shall have reached a point equal in proportion to the capital invested; that the price charged to the ratepayers for the arc street-lamps shall bear a fair, but not an exorbitant, profit; that the Committee shall be prevented from supplying electricity for public or any other purposes except at a fair market price, which shall appear in regular order in their published issues; and that out of their first balance in hand the sum of £13,000 shall be repaid to the borough fund, from which it was borrowed many years ago for the purposes of the electrical undertaking.

Dealing with this statement, the Engineer said that the cost was only 7-10oths of a penny more in Bristol than in Belfast. The units sold in Bristol were less than in Belfast, having regard to the capital expenditure; but this was owing to the difference in load-factor, which was better in Belfast than in Bristol, presumably owing to a greater proportion of power being sold. This would be very soon remedied; and if Belfast did not make any progress within the next eighteen months Bristol would have a better load-factor. As regarded capital expenditure, Bristol covered such a large area that the outlay, on mains especially, was abnormal. The cost per unit to the private consumer in Manchester was 1·08d.; in Bristol, 1·62d.; and in Belfast, 2·08d. Alderman Lloyd pointed out that in Belfast the tramways power was supplied, which increased the load considerably. The Inspector remarked that in 1907 it was admitted there was a good deal of over-capitalization; but the undertaking had certainly been doing better in the last two or three years, and getting stronger financially. Most undertakings had had at different periods a rather hard time. Bristol had not been an exception, and had had its hard time up to the last two or three years, which distinctly showed a strong improvement. The capital charges could only be reduced by largely increasing the output or reducing the capital expenditure by using the profits to prevent further borrowing.

MANSFIELD CORPORATION PROFITS.

Though its location in the heart of one of the richest coalfields in the Midlands has not saved Mansfield from feeling the effect of the enhanced prices of coal, the Corporation of the principal North Notts town have reaped a fairly substantial reward during the past year from their chief trading concerns. According to the reports presented at Friday evening's meeting of the Council, the profits on the Gas Committee's operations have only fallen by about £600 compared with the previous twelve months; but seeing that coal has cost £2000 more, and the wages are responsible for an increase of £230, the result cannot be regarded as other than satisfactory. Upon the manufacturing side of the Committee's operations, the income, considering the capacity of the works, has also been encouraging; 191 tons of sulphate of ammonia having been manufactured and sold during the year. The net profit from this source was £1185. The proposal was adopted to allocate from the gas profits £1500 in relief of the rates; while from the Water Committee's revenue a larger sum—£2000—is this year to be taken. The electricity profits will contribute £600; and despite increased expenditure entailed by the purchase of new meters, and of the large increase in the price of coal, it was mentioned in reference to the undertaking that the revenue had shown such a healthy expansion that these extra expenses had been met, and a further considerable contribution to reserve was rendered possible.

A possible early extension of the resources of the water undertaking was foreshadowed. Alderman Allcock intimated that recent experience of a very large increase in consumption had, although there was no

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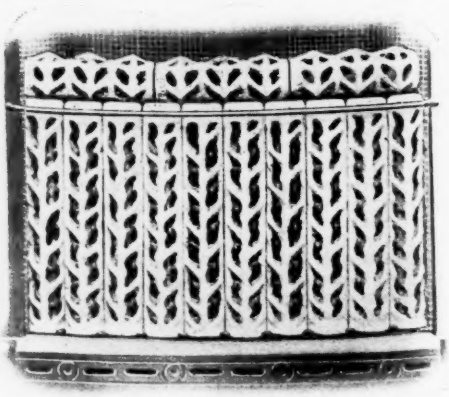

The THERMO-X Firefront.

The RADIANT (Thermo-X)

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shortage then experienced, drawn attention to the necessity of the early consideration of the construction of a new reservoir. The matter would be dealt with when the new Engineer came to reside in the town. In relation to the gas undertaking, attention was called by the Chairman of the Committee (Mr. T. Smith) to the circumstance that there had been during the year a somewhat extraordinary leakage, amounting to 10·2 per cent., compared with 7·3 per cent. in the previous twelve months.

TIVERTON GAS UNDERTAKING.

At the meeting of the Tiverton Town Council last week, the Lighting Committee reported that the net profit of the gas undertaking for the past year was £636. The Finance Committee recommended that of this £350 be allocated to the district fund, and the balance to the reserve fund of the gas undertaking.

Alderman JOHN THORNE (the Chairman of the Lighting Committee) said that at the last meeting, when he made a statement with regard to the profits on the gas-works for the past year, the accounts were not audited. Since the audit, however, the accounts showed an additional profit of £40. He expressed the indebtedness of the Council to the Gas Manager (Mr. Clark Jeffery) and his loyal staff, all of whom appeared to do their level-best in the interests of the Council and the town. During the time the gas undertaking had been in the hands of the Council, a sum of £1875 had been allocated to the relief of the rates, including the present £350. This statement should disabuse the mind of anyone who imagined that the gas-works were not a valuable asset to the town. The profits had been secured without taking any undue advantage of the consumers. Of seventeen towns of similar size to Tiverton, only one charged less—namely, Yeovil, where gas was 3s. 2d. per 1000 cubic feet, as compared with 3s. 3d. at Tiverton.

Alderman LAKE thought it would have been wiser if the Lighting Committee had kept all the profit of the year so as to provide some trading capital, and thus prevent having an overdraft at the bank.

Alderman AMORY said the satisfactory state of affairs was largely due to the interest taken in the undertaking by Alderman John Thorne, who had been Chairman of the Lighting Committee for eighteen years.

The report was adopted.

"Fining" a Gas Company.—At a meeting of the Ardee (co. Louth) Town Commissioners, the Town Clerk brought under notice the Gas Company's account, which, he said, was usually paid in August. He added that in December last an order was made that £10 should be deducted from the account, owing to the unsatisfactory lighting of the town; and he wished to know if a further deduction was to be made now, since dissatisfaction continued to prevail. The Commissioners decided to deduct £10 in this instance also, "by way of fine."

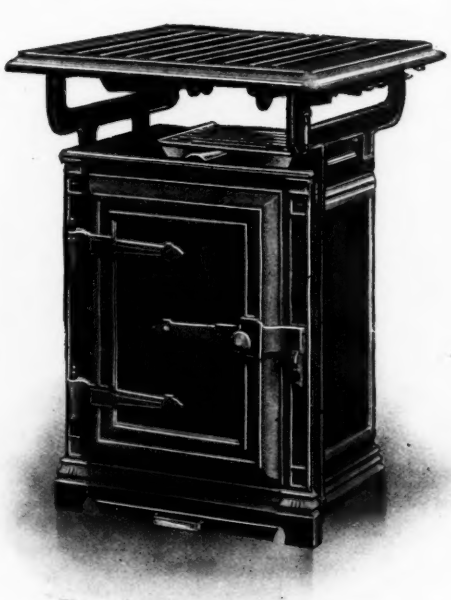
ILKESTON GAS-WORKERS' ORGANIZATION.

Described by one of the members of the Corporation, who accorded his presence to the inaugural proceedings, as the only "fighting" trade union body in the district, the Ilkeston gas workers, acting under the auspices of the National Union, have entered upon an ambitious scheme; a building in St. Mary Street, which is to to be known as the Gas-Workers' Hall, being opened last week. The project derives added importance from the movement which is on foot to run a Labour candidate for this part of Derbyshire, at present represented by Colonel J. B. Seely, Secretary of State for War.

The hall, which was formally opened by Mr. Arthur Hayday, of Nottingham, the District Secretary of the Union, is designed to form a centre of trade union operations, in which the gas workers have taken the lead; and naturally the occasion was utilized to the utmost to sound the praises of the organization of which Mr. Will Thorne, M.P., is the head. It was claimed by Councillor J. Pounder, who is the Branch Secretary, that, despite the pessimistic predictions which were forthcoming when the organizing work was commenced locally, the No. 1 Ilkeston Branch was now the largest in the district; while there was a second branch which was gradually adding to the number of its members. Councillor F. G. Robinson declared that, as a member of the Gas Committee, if he could honestly and honourably render the men a service, he was prepared to do so. Whether the scheme portends any further exacting demands upon the already much harassed Gas Committee, remains to be disclosed. Ilkeston at present possesses only one municipal revenue-earning concern to which any importance can be attached; this being represented by the gas undertaking. The smallness of the reserve existing in regard to this branch of municipal enterprise scarcely appears to warrant any further raids upon revenue—though the demands may emanate from the authorities of the newly, acquired "hall."

High-Pressure Gas Lighting at Belfast.—The Police Committee of the Belfast Corporation last week discussed the question of continuing the high-pressure gas-lighting that has been for some time so much admired in the two main thoroughfares—Royal Avenue and York Street; but it was agreed to let the matter stand for further consideration after an inspection by members of the Committee during lighting hours.

German Tar Products.—The German Tar Products Union made sales amounting to 947,107 tons last year, against 796,564 tons in 1911. The increase fell mostly to tar oil and pitch. The more favourable result respecting pitch is stated to be not due merely to the larger demand for the purpose of briquetting coal smalls, but also because of its more extended requirement for use in other directions, one of these being the briquetting of ore. As to the uses to which tar oil has been put, this was most signalized in its application as fuel for Diesel motors, and also as a heating fuel in the heavy metal industries.



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The Cookers comprised in our new 30-40 series are a revelation in value. They embody features which are usually only to be found in the most costly cookers, such as—to deal with the hotplate only—the following:—

Lifting Cornice (fixed if required) Wrought-Iron Bars which do not fall out when cornice is raised. Double reversible grill, which when reversed gives an absolutely vertical flame for boiling. All burners removable and interchangeable and fitted with gas and air adjusters. The cornice itself is roomy and of handsome appearance.

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MANUFACTURE OF GAS-RETORTS.

The Refractory Materials Committee's Specification Criticized and Defended.

In the course of an article by a "Gas Engineer" in the Engineering Supplement to "The Times" for the 8th inst., he made the following remarks on the subject of the manufacture of gas-retorts.

Within comparatively recent years, and at a time when the British fire-clay manufacturer seemed to be in danger of foreign rivalry, a Special Committee was appointed by the Institution of Gas Engineers to inquire into the inferiority of the home-produced article. In the course of time, this Committee, after exhaustive consideration of the scientific and thereotical principles of the question, recommended a "standard" material and specific method of preparation for gas-retorts —the ultimate aim being to gain increased refractoriness. For some time now the fire-clay concerns have been producing the exceptional article in conformity with the specification laid down by the experts; and thus it has become possible to form some opinion as to the practical outcome of the proposals. It cannot, unfortunately, be said that the well-tended offspring of the Committee is altogether an unqualified success; and though it is pointed out that "there are retorts working in this country to-day which are credited with a life of 2000 days," it must be recalled that in no small number of cases it has been a hard fight to keep them together for so short a period as 500 days. Judging from those retorts which have done their time, it would appear that mechanical strength (so necessary to withstand the straining and buffeting of the present-day stoking machinery) has been sacrificed to a large extent for extreme refractoriness, with results that are anything but gratifying to the careful gas engineer. The chief cause of the trouble would seem to be the excessive friability of the material, owing to a too liberal use of originally burnt clay, or "grog;" and the detached appearance of the newly-made retorts, with their coarse and open texture, appears to inspire anything but confidence in the prospective purchaser. It is a well-known fact, of course, that an extremely fine grain is not conducive to high refractoriness: but, on the other hand, it cannot but be thought that the open grain idea can be carried a trifle too far. At the present time, the situation is somewhat unsatisfactory; and many engineers are disposed to return to the original material, which has at least the merit of being cheap.

These remarks were replied to by Mr. F. J. Bywater, the Hon. Secretary of the Committee, in the following letter (sent from the offices of the Institution), which appeared last Wednesday.

The contributor of the article has, it would appear, allowed brevity to mask both his knowledge of his subject and the doings of the Joint Committee of Engineers and Manufacturers who were responsible for the preparation of the standard specification; otherwise it is difficult to account for some of the misleading statements made by him. I do not propose to notice all these in detail. But I wish to correct his statement, or inference conveyed, that the standard specification lays down rules and regulations as to the manufacture of retorts. There is practically no mention throughout the specification of manufacturing details, into which the Committee have repeatedly stated they were unwilling to enter; and the only reference to such details was inserted after very careful consideration of the matter, and particularly of the views of those members of the Committee who were engaged in the manufacture of retorts.

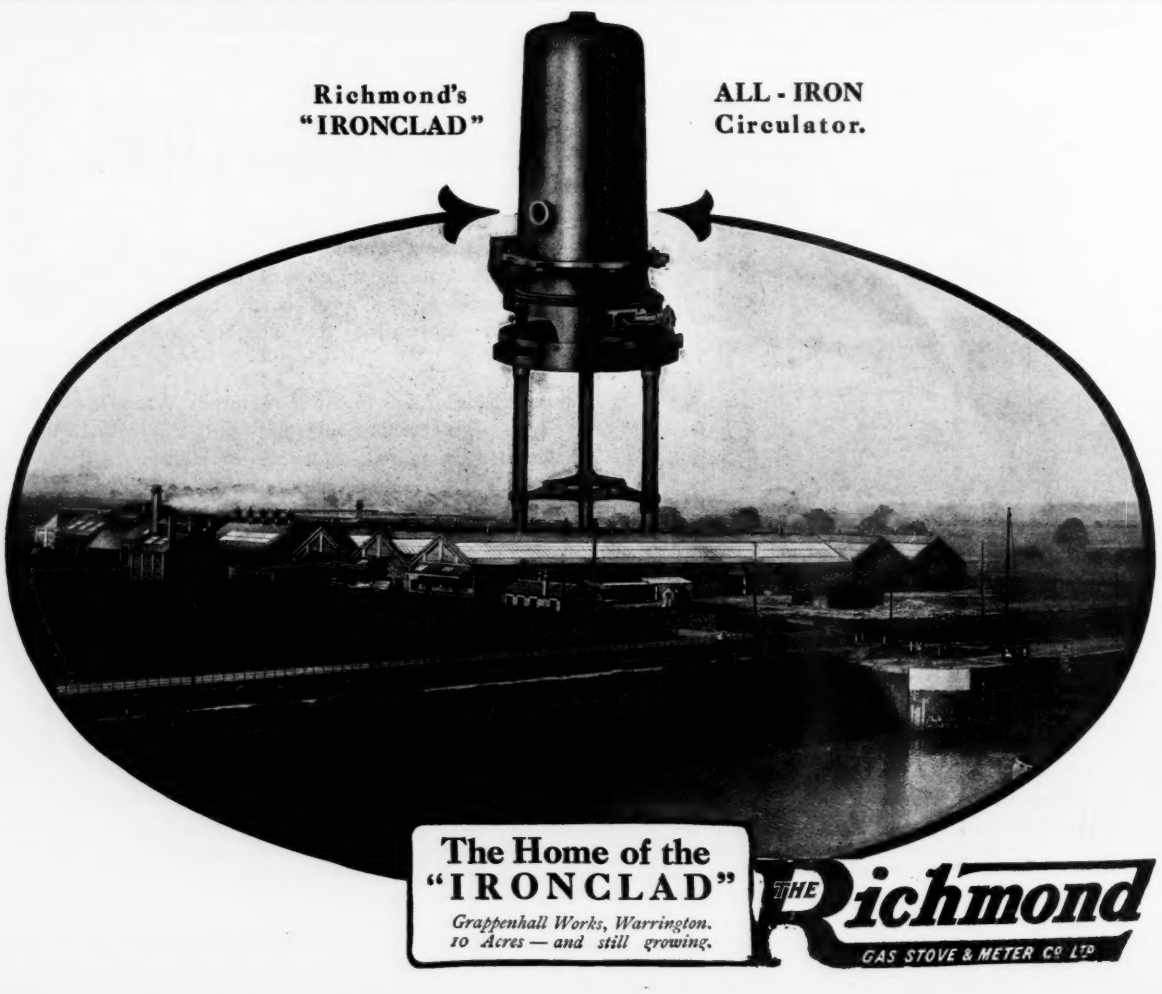
With regard to the coarseness in texture of some of the retorts which have been made to the standard specification, I would point out that the Committee, before preparing the specification, examined and tested a large number of samples of the best retort material available in this country at that time. The average porosity of these samples was found to be 17·9 per cent.; and as it is beyond dispute that retorts should not be dense and close-grained, a minimum porosity of 18 per cent. was stipulated. It will be seen, therefore, that the Committee made practically no departure in this respect from the best established practice before the specification was published; and, in fact, they have repeatedly stated that they wished to avoid rendering it necessary for manufacturers to make violent departures from existing methods, but rather to lead them, by well-considered steps, to prepare material which theory and practice show is desirable.

Unfortunately, some of the first retorts made to the specification had a porosity of as much as 30 per cent.; and it is to be feared that these have not given entirely satisfactory results. But, having regard to the porosity specified, and to the warning mentioned above as to the undesirability of extensive departure from previous practice, it cannot be said that the specification is responsible for these results.

All who have had experience of this subject know how very complicated and involved it is; and it is not surprising that all the efforts of the manufacturers to improve their material have not been attended with entire success. But criticism made hastily or without full knowledge of the circumstances cannot possibly do any good.

COKE INDUSTRY OF THE UNITED STATES.

According to some particulars contained in the number of the "American Gaslight Journal" for the 7th inst., the coke industry of the United States has now reached the $100,000,000 mark, and there is a steadily growing increase in the proportion of coke made in bye-product and retort ovens. The valuable residuals—gas, tar, ammonia, &c.—are saved by this process to the value of tens of millions of dollars annually. Where the coke is made in beehive ovens, these products are wasted. The total production of coke last year, according to Mr. E. W. Parker, of the United States Geological Survey, was 43,916,834 short tons, valued at $111,523,336. The production of beehive coke increased 5,164,701 tons, or 18 per cent.; while retort coke



increased 3,200,644 tons, or 49 per cent. Though larger than in 1911, the output of beehive coke did not reach the record figures for 1910.

The following table shows both the general increase in coke production and the rapid strides by which the bye-product industry is overtaking the beehive production:

Year.	Bye-Product Coke. Tons.	Beehive Coke. Tons.	Total. Tons.
1893 . . .	12,850 ..	9,464,730 ..	9,477,580
1901 . . .	1,179,900 ..	20,615,833 ..	21,795,883
1907 . . .	5,607,899 ..	35,171,665 ..	40,779,564
1908 . . .	4,201,226 ..	21,832,292 ..	26,033,518
1909 . . .	6,254,644 ..	33,060,421 ..	39,315,065
1910 . . .	7,138,734 ..	34,570,076 ..	41,708,810
1911 . . .	7,847,845 ..	27,703,644 ..	35,551,489
1912 . . .	11,048,489 ..	32,868,344 ..	43,916,834

The number of retort-ovens in operation increased from 4624 in 1911 to 5061 in 1912 – a gain of 437; whereas the total number of all ovens decreased from 103,879 to 102,080, thus indicating that there were 2236 fewer beehive ovens in operation last year than in 1911. Some new ovens of the beehive type were built in 1912; but the number abandoned exceeded these. There were nearly 1000 retort-ovens under construction at the close of the year, and contracts had been made for a number of additional plants. The marked progress made in retort-oven construction during the last two or three years, and the new work under way or in contemplation, are carrying forward the revolution in coke making which was noted as inevitable in one of the earlier Survey reports. This revolution consists in the gradual substitution of retort-ovens for the beehive type, and in shifting the coke-making industry from the vicinity of the mines to the centres of manufacture and population, where the gases can be utilized.

The quantity of coal required to produce a ton of coke is much less than formerly. The average gain in 1912, compared with ten years ago, is at least 160 lbs. It is doubtful whether in the earlier years the actual yield from coal exceeded 60 per cent.; whereas last year it was 67 per cent. This gain is largely due to the increased production of bye-product coke.

In Illinois, Indiana, Massachusetts, Michigan, New Jersey, New York, and Wisconsin, where coke is made exclusively in bye-product plants, the yield varies from 69·6 per cent. (Wisconsin) to 81·8 per cent. (Indiana); in States where beehive practice prevails, the yield varied from 50 per cent. (Georgia) to 66·5 per cent. (Pennsylvania).

London County Council and Testing High-Pressure Gas-Meters.—The report by the Public Control Committee of the London County Council on the subject of obtaining legislative sanction for the testing of high-pressure gas-meters, given in the "JOURNAL" last Tuesday, came before the Council that day, and the Committee's recommendation that notice should be given of the intention to consider the matter at a special meeting on the 29th inst. was agreed to.

NOTTINGHAM GAS EMPLOYEES' STRIKE.

Though there had been a suggestion of a possible development of the trouble involving other of the Council employees, the dispute at Nottingham affecting the tinsmiths at the Corporation gas-meter repairing shops again dragged its weary length along last week, without the anticipated extension of strife occurring. There had been plentiful talk as to a cessation of operations by other trade unionists, in sympathy with members of the National Amalgamation of Sheet Metal Workers; but the threatened general mobilization of the forces did not materialize. Meanwhile, the tinsmiths have been left to their own resources. The general plan of campaign had been to sound the Executives of the various unions whose members are in the service of the Corporation, upon the question of the enforcement of the demand for a minimum wage of 6½d. per hour, and the ostracism of all non-union labour. The result of the voting by the several sections, which was to have been made known on Saturday, was awaited with interest. But inquiries in trade union official quarters elicited that there must be further delay until Thursday next, when the whole matter will, it was understood, be again debated.

INGENIOUS DEVICE FOR STEALING GAS.

Ice Discs for Working a Prepayment Meter.

Mr. J. Carmichael, the Manager of the Barrhead Gas Company, has sent us a cutting from a newspaper published in Honolulu, where his son is engaged as an engineer, showing how a cook succeeded in surreptitiously obtaining a quantity of gas through a prepayment meter. The following is the story.

Mr. Harry L. Strange, the brisk young Manager of the Honolulu Gas Company, who has recently returned from the mainland with a suit-case full of new ideas whereby the public of Honolulu may be better served, also brings back a report on the latest scientific way of beating a quarter-in-the-slot meter, such as so many in Honolulu have, in order to let the Oriental cook realize that it is money burning up when he touches his match to the range.

"The man who rented this meter," says Mr. Strange, "was known to be tampering with it; and for a year the Gas Company were at a complete loss to locate even a clue as to his method. He would not put a quarter in the meter, and yet he used a great deal of gas. The Company changed the meters almost weekly, and yet they could not catch him. In reply to the questioning of the Company's officials, he would just reply that the gas did not give out, and that he would not put a quarter in until it did. The Gas Company threatened, wrote letters, sent inspectors, and did many other things to get him to turn from his method; but all to no avail. At last

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they made him a proposition, and offered him a sum of money and a guarantee that they would not prosecute him if he would show them his method. He took them at their word, and a meeting was arranged in his basement. From his work-bench drawer he took a steel mould and an ether freezing-machine such as is used in connection with certain applications of the microscope. He poured a little water into the mould, and a few seconds' application of the freezing spray turned the water into a hard disc of ice the size of a quarter. This he dropped into the meter. It performed the work of the coin, and after a short time melted and ran out; the moisture went into the bottom of the machine."

Mr. Strange was asked by the writer of the story what the Gas Company thought of it; and the reply was that "it took them a long time to get over the shock."

NOTTINGHAM CORPORATION WATER SUPPLY.

The Mistake of Participating in the Derwent Scheme.

The further the considerations in relation to Nottingham's participation in the Derwent Valley scheme are examined, writes our local correspondent, the less inviting does the prospect appear. By Mr. A. R. Atkey, the Chairman of the Water Committee, the declaration has lately been made that Nottingham's alliance in the matter with Sheffield, Leicester, and Derby represents the "greatest blunder" which the Municipality has ever made. He gave credit to those who pledged Nottingham to the scheme for acting as they considered best in the city's interest in their day and generation. While realizing that the Derwent source would valuably conserve the existing supplies to the city, he enforced the consideration that it was a mistake to suppose it would give a perfect supply for all time; pointing out that when it was in full working order it would only meet 25 per cent. of the requirements. It was from this point of view, therefore, that he regarded the conception of the scheme as being so utterly unjustifiable and disastrous. In view of the heavy annual expenditure to which the Corporation now stand committed in their partnership with the other authorities, it is distinctly vexatious to Nottingham ratepayers now to learn, upon Mr. Atkey's authority, that at Burton Joyce, which is only a few miles from the municipal boundary, one new source of supply has been successfully tapped at a cost which, for capital outlay, does not amount to more than one year's interest for which Nottingham is liable under the Derwent Board compact; and, as if this were not sufficient, there is the further irritating consideration that at Mapperley, contiguous to the municipal boundary, there is another valuable yield, which, through opposition on the part of the smaller authorities interested, was being allowed to run to waste. The Corporation, according to the explanation given by the Chairman of the Water Committee, have been prevented from exploiting the supply which there also might have been had in plentiful volume. Significant of the dog-in-the-manger policy which often obtains where conflicting interests are involved, the Mapperley borehole had been blocked up; and yet such is the volume and force of the water that it has made its way out again, and was recently running to waste at the rate of 2 million gallons a day. Added to the unpleasant reflections to which Nottingham's financial obligation in the Derbyshire venture has given rise, complaints as to the alleged doubtful quality of the Derwent Valley water are being renewed locally on all sides; the feeling finding expression in a demand for an independent official analysis, despite Mr. Atkey's protest as to the utterly unreasonable nature of the criticism, and his declaration as to the absolute purity of the supply.

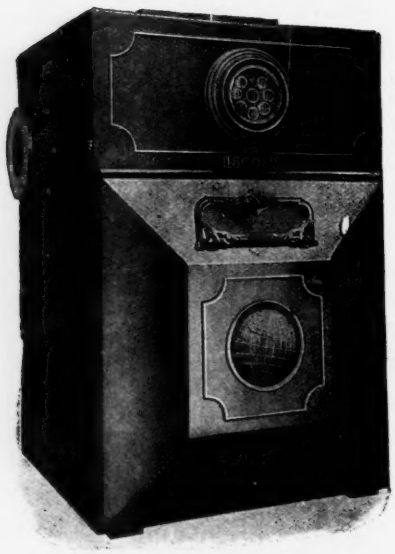
WATER SUPPLIES FROM RIVERS.

In the Engineering Section of the Royal Sanitary Institute Congress at the recent meeting in Exeter, Mr. W. PHELPS submitted a paper on the subject of "Water Supplies from Rivers."

The author said his intention was to consider the supply of water for rural districts, for which a definite policy might be required and adopted with advantage, rather than that to towns, where, generally speaking, a definite supply and settled policy had already been adopted. He dealt with the conditions obtaining in other countries, and said there was no consensus of opinion in the direction of adopting a general policy of forsaking river supplies either here or abroad. It had been the custom, to a great extent, among engineers and others, to consider all deep well waters and large springs as being suitable sources of supply without treatment and safe from pollution; but this attitude had of late years undergone a change. Probably more epidemics of water-borne disease could be traced to the pollution of deep well waters and springs than had been caused by river water properly treated. This was particularly the case where the wells or springs were situated in a fissured formation and the vicinity of populated areas, and did not generally apply with the same force to springs rising at a considerable altitude. From the latter he had provided supplies to a large number of rural areas by gravitation; and it was these that he recommended for use wherever possible, in the first place as being the most free from pollution. When they came to consider the economic bearing of this question, another very good reason might be found in favour of upland springs as a source of supply for rural areas. Pumping in millions of gallons per day was not comparatively a very expensive operation, but when they came to so deal with (say) 50,000 to 100,000 gallons per day, the cost was comparatively much higher. In his experience, supplemented by information from those in charge of similar works, the cost of pumping for supplies of the extent named averaged not less than 2½d. per 1000 gallons. This was equal to an annual charge of £190 in the first case, or £380 in the latter.

The author's suggestion of a policy was that, as regarded the watershed areas not yet taken, the upland springs should first be appropriated

BRADDOCK'S IMPROVED GAS METERS



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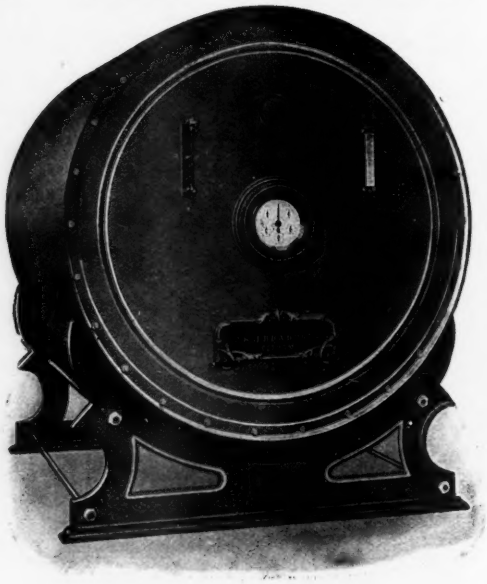

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to the use of the dwellers in that river basin. Having regard to the probability of increased population or the needs of coast towns not yet sufficiently equipped for future needs, some help should be given from a central fund, where such was advisable, to enable mains to be laid large enough to convey not only the collected springs, but, as occasion might require, the whole or a large part of the surface yield of the collecting area. Storage reservoirs and filters on the watershed area might be added from time to time as might become necessary. This would obviate the difficulties commonly encountered from the fouling of trunk mains by vegetable growths due to the conveyance of unfiltered water. He realized that no co-ordinating machinery at present existed to deal with a river basin on the comprehensive lines suggested, and it was to be hoped that when legislation took place the needs and financial limitations of the rural areas would receive the fullest consideration.

Mr. A. G. Martin (London) said the subject was of importance to rural districts, and the author had done good service in suggesting the propriety of dealing with problems of this kind on broad lines, and supplying possibly a large number of parishes by a combined scheme. He had in mind the case of a large number of villages situated on the Oxfordshire clay, which was simply a heartrending formation from which to get water. As a matter of fact, there was no water fit for use; and in this particular case it was brought a distance of 16 or 18 miles, and distributed at a cost of 4½d. or 5d. per 1000 gallons. This showed what was possible by combined action.

Dr. Garrett (Cheltenham) said his town had power to take water from the Severn for their own supply and also for Tewkesbury, and some years ago it was his duty to report on the subject. He visited all the towns on the Severn, and estimated the amount of impurity going into the river, which was considerable. Practically speaking, the majority of towns on the Severn took their water from a point above, and put their sewage into the river below the towns. He took samples of the water above and below these towns, and in every case he found that within a few miles of the places where the sewage was discharged the river had come back to its original state of purity, with the exception, of course, that there was added to the water some amount of inorganic material, and the water became harder. The result of his investigations was that he was able to advise that water could be taken from the Severn and used with safety; and it had been so used since. Lately they had introduced plant for a rough filtration of the water, as they had no facilities for storing the water over a period, as had been advocated by Dr. Houston, the Director of Water Examination of the Metropolitan Water Board; and, in this connection, he wished to emphasize the great value of the addition of chloride of lime to the water before filtration.

Mr. Moss Flower expressed the opinion that if the local authorities did their duty in regard to sewage disposal, there would be no difficulty in getting good water for all the districts of the country.

Mr. Phelps, in reply said he was quite aware that water which had been polluted could be pumped and filtered; but his argument rather was whether this was worth doing. If they could collect water which had been naturally filtered through the soil at high levels where no pollution existed, and could bring it by gravitation to the inhabitants, was it worth while to allow it to pass down to a stream where it was polluted by the drainage from farmsteads, and then pump it to the top of a hill and filter it and pass it on?

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Blairgowrie.—The Town Council have been notified that Messrs. Foote and Milne, of London, are to apply to the Board of Trade for a Provisional Order to supply electricity within the area of the Town Council.

Broughty Ferry.—The Dundee Town Council will take over the gas-works after the November elections, when Mr. Keillor goes under their control as Assistant Engineer and Manager. No doubt the salary will not be any the worse in the new appointment; but it is understood that no compensation is to be given to him for the loss of prestige, status, &c. There is no doubt that the new position is a very different one from that of having complete charge. It seems that the Broughty Ferry officials felt obliged to petition, on their own behalf, to obtain the best possible conditions under the Dundee Town Council. The works will probably be continued in working until May next, when the full supply will be obtained from Dundee, and the works at Broughty Ferry scrapped and used only as a holder station and for the showing and distributing of stoves, &c. It is thought that a boosting plant will be installed to deliver Dundee gas to the holders, whence it will be distributed through the present pipes. The holder accommodation in Dundee just now is about 60 per cent. of the maximum daily sale, throwing only a small pressure for distributing over a large area; while the Broughty Ferry storage capacity is also only about 62 per cent. It was shown in the annexation evidence that the price of gas in the Ferry is now 2s. 6½d. net, as against 2s. 0½d. net in Dundee, with the discount off. The former, however, are paying off their indebtedness, at the rate of 2d. per 1000 cubic feet sold, quicker than Dundee; so that really the only difference is 4d. per 1000 cubic feet. There is also a cash surplus of £1700, or equal to a reduction of 6d. per 1000 cubic feet. The Broughty Ferry Gas Department was shown to be in an excellent position and well managed, which speaks well for Mr. Keillor's work there. That stoves and cookers have not been neglected is shown by the average day and night consumption, which is stated to be 54¼ per cent. and 45¾ per cent. in summer and 48⅛ per cent. and 51⅞ per cent. respectively in winter.

Castle Douglas.—A goodly sum has been placed to reserve by the Gas Company, and a dividend of 7 per cent. and a bonus of 3 per cent. paid. The Manager (Mr. R. Croll) showed that coal had risen by 4s. 2d. per ton; but the price of gas (3s. 6½d. per 1000 cubic feet) is not to be raised.

Cupar.—The dividend to be paid by the Gas Company is to be 40s.

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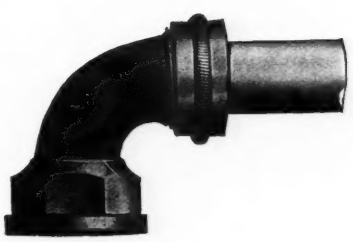

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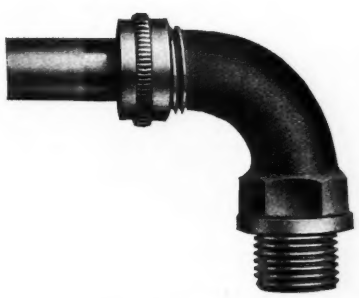

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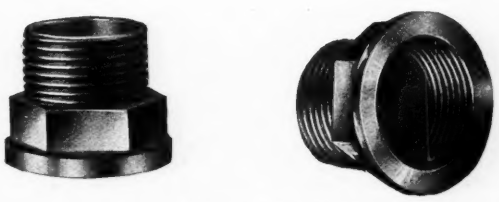

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per share on the ordinary shares, and 5 per cent. on the preference shares.

Dalkeith.—The Electric Supply Corporation, Limited, London, have offered to renew their contract for five years, reducing the price per lamp from £2 to 33s., and to make good all breakages. The Town Council agreed to accept the offer of the Electric Supply Corporation.

Dunfermline.—The extra cost of coal has been £287 in 1911-12 and £1677 in 1912-13, and next year it is estimated at £3185. Despite this increase, the price of gas is not to be raised. Mr. Thomas Stewart, in presenting the estimates, referred to the probable increase in the consumption which was expected from the greater population, and prophesied that the gas-works would be the most profitable department of the Town Council. He also complimented Mr. Alexander Waddell, the Gas Manager, on the success.

A curious case has arisen of a burgh engineer being sued for his water-rates. It seems that on Jan. 29 the notice to pay was served, stating thereon that the rate was payable on or before Jan. 20, and appeals against the assessment had to be made by Jan. 14. The Fife County Council, in whose area the house was situated before the extensions of the burgh boundaries, could not supply the engineer, and he laid a pipe from the Dunfermline supply. He had received no water from the County Council; but they contend that, his property being within their water area, only an Act of Parliament can absolve him from paying the rate. The Sheriff has now held the action over until the disposal of the appeal made by the defender—he holding that the lateness of the notice did not prevent the Council from taking action, but it allowed the defender to present an appeal at a later date, which he had done; and this appeal must be heard before the Sheriff would decide the action.

Inverurie.—A dividend of 6½ per cent. has been declared by the Gas Company, despite a recent reduction of 5d. per 1000 cubic feet in the price of gas.

Paisley.—The annual report of Mr. James Lee, the Water Engineer, has been delivered. There have been 10,353 gallons daily increase in the Paisley district, and at the same time a decrease of 96,439 gallons in the Johnstone district; so that the net decrease is 86,086 gallons per day. The latter district shows a total daily consumption of 55⅝ gallons per head. In the Paisley district, the consumption is 77 gallons per head for all purposes.

Peebles.—Scarcity of water in the district is complained of, and the erection of a storage tank to hold 50,000 gallons is suggested. The Provost, Mr. Ballantyne, hoped that the Council would make use of the Kirkhope Burn site, where they had a natural position for a reservoir, and which site they had purchased.

Selkirk.—An increased quantity of gas, amounting to about 2 per cent., has been sent out by the Gas Company during the past year; while the profits amount to £1891, from which a dividend of 5 per cent. is to be paid. There is to be no alteration in the charge for gas, as coal contracts of a favourable nature have been arranged.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *July* 19.

Sulphate of Ammonia.

The slight improvement which took place last week in the market for this material has not been maintained this week. Fresh orders from consumers have continued to be scarce, and, although the requirements of dealers for fulfilling previous engagements have been considerable, the present output has proved ample for all needs. The nearest values at the close are £12 16s. 3d. per ton f.o.b. Hull, £12 17s. 6d. per ton f.o.b. Liverpool, and £12 18s. 9d. per ton f.o.b. Leith. Little new business has transpired for future shipment; but it is reported that producers have accepted £13 2s. 6d. per ton for delivery up to December next, and £13 7s. 6d. per ton for January-June, 1914, f.o.b. principal ports, in equal monthly quantities.

Nitrate of Soda.

There is no change in this article, and quotations are repeated at 10s. 4½d. per cwt. for ordinary and 10s. 7½d. for refined quality on spot.

LONDON, *July* 21.

Tar Products.

There is practically no change in the markets for tar products, and business is still very quiet. Pitch remains in the same position; and no business of any consequence has been reported during the week which is likely to have any effect on the market either way. Consumers are expecting a further lowering in the value, and, consequently, are not eager purchasers at the moment. Benzols are steady; but business is quiet, and there is little doing. There is practically no alteration in the value. In naphthas, there is not much business, and the price remains the same. Some business is reported in crude carbolic; and by the prices which have been paid for this year's delivery, it would appear that some dealers are covering in against contracts made some time ago. A little business is reported in creosote, though reports speak of very reasonable prices being accepted for country makes. The quotation in London keeps fairly steady.

The average values during the week were: Tar, 25s. 3d. to 29s. 3d. Pitch, London, 41s. to 42s.; east coast, 40s. 6d. to 41s. 6d.; west coast, Manchester, 40s. to 41s.; Liverpool, 41s. to 42s.; Clyde, 41s. to 42s. Benzol, 90 per cent., naked, London, 1s. 0½d. to 1s. 1d.; North, 1s. to 1s. 0½d.; 50-90 per cent., naked, London, 10d. to 10½d.; North, 10d. Toluol, naked, London, 11d. to 11½d.; North, 11d. Crude naphtha, in bulk, London, 5½d. to 5⅝d.; North, 4⅝d. to 5½d. Solvent naphtha, naked, London, 11d. to 11½d.; North, 9d. to 9½d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10d. to 10½d. f.o.b. Creosote, in bulk, London, 3⅜d. to 3¾d.; North, 2⅝d. to 3d. Heavy oils, in bulk, 3⅜d. to 3⅝d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 1s. 3d. to 1s. 4d. Naphthalene, £5 to £9; salts, 50s. to 55s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

Sulphate of Ammonia.

There is little or nothing doing in this market at the present moment; and in one or two cases lower prices have been accepted

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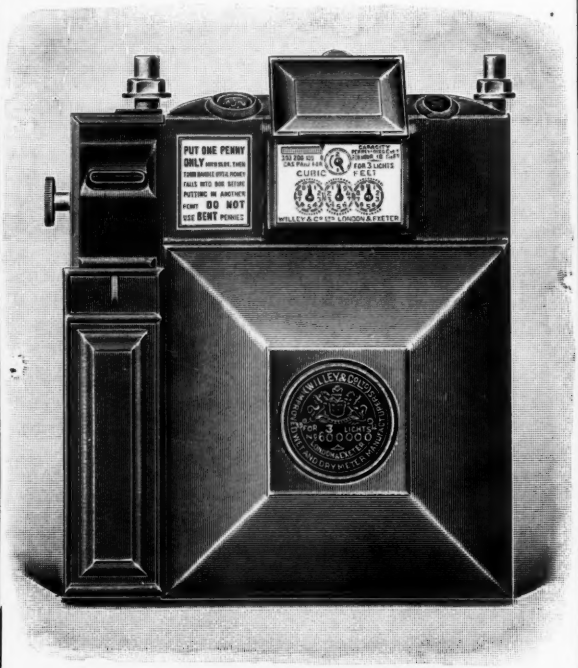
2nd.—The Slot is closed when the maximum number of Coins have been inserted.

3rd.—Our Price-Changing System is the Simplest, Quickest, and most Accurate yet devised.



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where makers have been anxious to clear out their stocks. The future does not look at all promising, seeing the increase in production. Outside London makes are still quoted at £12 5s., though there are reports of lower prices being accepted. In Hull, the price is £12 16s. 3d.; Liverpool, £12 17s. 6d.; Leith, £12 18s. 9d.; Middlesbrough, £12 16s. 3d.

"Tar Distiller" writes, under date of the 17th inst.: "Tar products are still maintaining their position, and if anything pitch is better. At Liverpool, 43s. 6d. has been paid for wholesale quantities; and this price has been offered for a large amount. There is no doubt this article is going back to its proper figure. Carbolic acid has been unduly depressed; and when the makers of this article realize their strength, there is very little doubt that we shall see an improvement in prices. The prices at present offered are such as to render the article unattractive to makers."

COAL TRADE REPORTS.

Northern Coal Trade.

There is a stronger demand for coal both for steam kinds and for Durham sorts in general. In steam coals, best Northumbrians are from 15s. to 15s. 3d. per ton f.o.b.; and there is a fairly full export demand. Second-class steams are about 13s. 3d per ton; and steam smalls are steady at from 8s. 3d. to 9s. 6d. per ton f.o.b., with higher quotations for some special classes. The output is still rather limited—work being kept back at the collieries by local holidays. In the gas coal trade, best Durhams are about 15s. per ton f.o.b.; second-class are generally quoted from 13s. 6d.; and for "Wear specials," from 15s. to 15s. 6d. is named. Tenders are being sent in now for 45,000 tons of gas coals for Christiana; but the prices are not yet known. Sales are reported for Italy at a price believed to be about 19s. 3d. delivered at Genoa – a figure which, with current freights, would be considerably below the prompt quotation for second-class gas coals. A large sale of coking coal for Bilbao—some 21,000 tons monthly, at 13s. to 13s. 3d. per ton f.o.b.—ought to stiffen the prices of Durham coals, including, of course, gas coals. Coke is rather easier; there being now a slight increase in the production. Good gas coke is quoted from 17s. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

The advent of the holidays has influenced the Scotch coal trade during the past week, and coalmasters look for good business when work at the collieries is resumed. On the Glasgow Coal Exchange, on Friday, the following were the approximate prices quoted: Ell coal, best brands, 12s. 6d.; splint, 12s. 9d. to 15s.; navigations, best, 16s. 6d. to 17s.; ordinary strains, 11s. to 12s.; Hartleys, 14s. 6d.; trebles, 12s. 6d.; doubles, 11s. 9d.; singles, 11s. 3d.; pearls, 10s. 6d.; dross, 6s. to 8s. 6d., f.o.b. Glasgow.

Rochdale Gas Undertaking.—The sanction of the Local Government Board to the Provisional Order authorizing the Rochdale Corporation to supply and fix free certain gas apparatus for domestic use was reported to the Gas Committee at their meeting last Wednesday. The central show-room is now being prepared.

Price of Gas at Goole.—The Goole Urban District Council have decided to reduce the price of gas from 3s. 2d. to 3s. per 1000 cubic feet to ordinary consumers; the change to take effect as from the quarter-day commencing on the 1st inst. Consumers of gas through prepayment meters will have 27 instead of 25 cubic feet for 1d. The Gas Committee of the Council have received a demand from the Aire and Calder Navigation, as the largest consumers of gas, for an additional allowance of discount, accompanied by the threat that otherwise the Navigation would seriously consider the adoption of electricity. The Council have replied calling attention to the reduction they have made in the price of gas, and stating that they will give the communication of the Navigation further consideration. The net profit of £3331 realized last year constitutes a record.

APPLICATIONS FOR LETTERS PATENT.

15,604.—Mackie, A. M., "Gas-engines." July 7.
15,609.—Gaslaternen Fernzundung G.m.b.H., "Actuating gas-cocks." July 7.
15,619.—Bonecourt Surface Combustion, Ltd., and Kirke, P. St. G., "Combustion of combustible mixtures." July 7.
15,667.—Bopp and Reuther, "Water-meter." July 7.
15,677.—Stephenson, J., "Generating water gas." July 7.
15,692.—Sutherland, J. G., and A. G. Sutherland, Ltd., "Dry meter." July 8.
15,730.—March, E., "Accelerating the flow of water in a conduit." July 8.
15,775.—Marot, P., "Acetylene generators." July 8.
15,819.—Davis, F. H., and Smith and Davis, Ltd., "Gas-burners." July 9.
15,888.—Whiston, H., "Mantle holder." July 10.
15,952.—Oudeville, F., "Heating baking-furnaces by gas." July 10.
15,965.—Koppers, H., "Separating light oils from washing oils and regenerating the latter." July 10.
15,990.—Fletcher, Russell, and Co., Ltd., and Fletcher, W., "Bunsen burners for high-pressure gas." July 11.
16,029.—Simmance, J. F., and Abady, J., "Gas-governors." July 11.
16,081.—Phillips, E., "Expanding pendant." July 12.
16,107.—Cook, T., "Conveying coke from vertical retorts." July 12.
16,110.—Havers, E. W., "Distance gas lighting." July 12.
16,114.—Fairfax, H. W. G., "Rotary engines and compressors." July 12.
16,128.—Fairweather, H. G. C., "Money boxes for meters, &c." A communication from the Ges. für Elektrische Industrie Akt.-Ges. July 12.
16,130.—Piller, P., "Measuring the pressure of gases." July 12.

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Cromer Water Supply.—The Cromer Urban District Council have decided to adopt, at an estimated outlay of £2000, a filtration scheme which has been found highly successful at other seaside resorts. The repayment would involve an annual charge equal to a 1d. rate. The adoption of the scheme will, it is believed, tend to much economy in the general working of the Water Department.

Poisoned Fish in the Roding.—Last Sunday, the River Roding, at a point known as Littlebury Mill, near Ongar, Essex, was covered with the floating bodies of hundreds of dead fish. The trouble is "believed" to be due to road-tarring operations in the district, followed by heavy rain. As a measure of precaution, farmers in the locality are keeping their cattle from the river for a time.

Parochial Electors and Borough Funds.—Under the Borough Funds Acts, 1872 and 1903, a local authority, other than a county council, cannot promote a Bill in Parliament unless a resolution approving of the Bill has been passed at a meeting of the parochial electors or at a subsequent poll if demanded, and a poll can be demanded by a hundred electors. A Bill has been drafted, upon the instructions of the Association of Municipal Corporations, by which it is proposed to repeal, in the case of municipal boroughs, the provisions of the Acts requiring a meeting of the parochial electors and a poll. The Bill was introduced last Tuesday by Mr. George Thorne, the Member for Wolverhampton, and it stands for second reading next Monday.

The tender of Messrs. Kettle and Son, of Loughborough, for £947, has been accepted by Messrs. G. & F. W. Hodson, the Engineers, for providing and laying cast-iron water-mains at Kingscliffe for the Oundle Rural District Council. This tender was the lowest of nine submitted; the highest being for £1149—a difference of £202.

The Bermondsey Borough Council have applied to the London County Council for sanction to the borrowing of £8682 for electricity mains and a switchboard; the Finance Committee think the loan should be sanctioned, repayable within the usual periods.

The Tillicoultry Town Council have decided to instal a complete installation of the "A. & M." patent automatic lighting and extinguishing apparatus, together with the Alder and Mackay hurricane proof copper lantern; and the Stockport Corporation will be installing 250 of the "A. & M." patent automatic controllers before the next lighting season.

Contracts for laying high-pressure mains for the Richmond (Surrey) Gas Company—to be placed under the footways on either side of the principal thoroughfares—and for the Leatherhead Gas Company to connect their works at Leatherhead with those at Cobham (about six miles distant) have been secured by Messrs. A. H. Ball and Co., Limited, of Farnham.

We learn that the band of the Compagnie du Gaz d'Anvers (Imperial Continental Gas Association) recently won the first prize in a competition at the Ghent Exhibition, and their bandmaster, M. Van Dyck, the conductor's prize. This success was celebrated last Tuesday by a reception at the house of Mr. A. F. P. Hayman, the Gas Engineer and Manager for the I.C.G.A. in Antwerp.

A concert was held at the Rotherhithe Gas-Works Institute of the South Metropolitan Gas Company on the 10th inst., on the occasion of the presentation of the prizes by Mrs. Sherwin, wife of the Secretary of the Institute, to the winners of the four-oared cutter race, which took place the previous Saturday. At the conclusion of the proceedings, Mr. Sherwin, who is leaving the Company, was presented by the Committee of the Institute with a pair of vases and a casket, in appreciation of his services.

GAS COMPANIES' STOCK AND SHARE LIST.

The Stock Exchange had its ups and downs last week; but, nevertheless, it was not at all a bad time on the whole. This is the more significant when the number of adverse factors supervening is reckoned with. The deplorable state of things in the Balkans, the prospect of civil war in China more threatening day by day, the severe unrest in the Rand, and labour clouds at home, go to make up a depressing aggregate. But markets in general have shown real strength, though business has not been abundant—a feature to be expected as we get nearer August. On the opening day, it seemed as if the Exchange might almost as well have remained closed, for business was about as slack as it well could be. All markets were inanimate and featureless. Prices hardly moved at all, and, if at all, then capriciously. A small failure was reported, but it was not influential. Tuesday showed a greatly improved tone, though actual business was small. The storm centres both abroad and at home were regarded more hopefully, and prices in all the leading departments looked up. Gilt-edged were quite strong, with easier discount as a special incentive, and Consols rose ½. Home Rails made moderate but level advances; and American and Foreign advanced. Wednesday started brightly; and markets developed fresh strength. But a pause ensued, and then realization of profits set in. Consols shaped easier, and Rails closed below the best; but American remained strong. Thursday was quite overcast; the aspect of Balkan and other Foreign affairs being regarded gloomily. Consols went down, and Home Rails and the Foreign Market gave way; but American held very firm in response to special circumstances. The air cleared on Friday, and brighter views prevailed, though no great peg to hang hopes upon might be discerned, and Continental advices were encouraging. Consols recovered, and markets in general held their heads up. Saturday's tone varied in the different markets; China and South Africa being the weakest spots. There was, however, no strong movement. Gilt-edged were not at their best, but Consols closed at 72⅞ to 73—a rise of ⅛ in the week. In the Money Market, the tendency was at first quite easier; but later on it settled down firmer. Business in the Gas Market was about a fair average, when allowance is made for the approach of the holiday season; and the tone was strong, with some nice advances in quotation. Two announcements of the result of the half-year's trading are made. The Gaslight and Coke Company will maintain their dividend and carry forward almost the same amount as six months ago. The ordinary stock was in good demand, realizing from 100⅞ to 103¼—a rise of 2⅛. In the secured issues, the maximum marked 75⅛, the preference 98, and the debentures 72½. South Metropolitan advanced 1½, with transactions at 109⅝ to 111, and the debenture made 72 and 73. In Commercials, the 4 per cent. fetched 106½ and 107, the 3½ per cent. 103 to 103⅜, and the debenture 69. Among the Suburban and Provincial group, Alliance fell 1½ at 67½, British marked 45⅛, South Suburban 117½, and ditto preference 115. Tottenham and Edmonton will recommend an increased dividend and carry forward a larger balance. In the Continental companies, Imperial changed hands at 163 to 165½, ditto debenture at 86½, Union at 80, European at 17⅞ to 18⅛, and Tuscan debenture at 95¼ and 95½. Among the undertakings of the remoter world, Bombay made 6 13/16, Cape Town preference 4, Primitiva 6 3/32 and 6⅛, and ditto preference 4⅞ to 5⅛.

Issue.	Share.	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,561,868	Stk.	April 11	5	Alliance & Dublin Ord.	66½–68½	−1½	7 6 0
374,000	,,	July 11	4	Do. 4 p.c. Deb.	80–83*	−2	4 16 5
280,000	5	April 11	7½	Bombay, Ltd.	6¼–6⅞	..	5 11 1
50,000	10	Feb. 27	15	Bourne-mouth Gas and Water | 10 p.c. | B 7 p.c. | Pref. 6 p.c.	28½–29½	..	5 1 8
332,000	10	,,	7		15½–16	..	4 7 6
75,000	10	,,	6		13½–14½	..	4 4 3
380,000	Stk.	Feb. 27	14	Brentford Consolidated	260–265	..	5 5 8
330,000	,,	,,	11	Do. New	200–205	..	5 7 4
50,000	,,	,,	5	Do. 5 p.c. Pref.	113–115	..	4 6 11
206,250	,,	June 13	4	Do. 4 p.c. Deb.	92–94	..	4 5 1
217,380	Stk.	Feb. 27	11	Brighton & Hove Orig.	206–211	..	5 4 3
244,200	,,	,,	8	Do. A Ord. Stk.	151–154	..	5 3 11
530,000	20	Mar. 28	12½	British	45–46	..	5 8 8
120,000	Stk.	June 27	4	Do. 4 p.c. Deb. Stk.	87–89	..	4 9 11
245,771	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	83½–91½	..	4 7 5
100,000	10	—	—	Cape Town & Dis., Ltd.	2–3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4–5	..	—
100,000	Stk.	June 27	4½	Do. 4½ p.c. Deb. Stk.	75–80	..	5 12 6
157,150	Stk.	Feb. 13	5	Chester 5 p.c. Ord.	139½–111½	..	4 9 8
1,513,280	Stk.	Feb. 27	5/9/4	Commercial 4 p.c. Stk.	105–107	..	5 2 1
560,000	,,	,,	5½	Do. 3½ p.c. do.	102–104	..	5 2 6
475,000	,,	June 13	3	Do. 3 p.c. Deb. Stk.	69–71	..	4 4 6
800,000	Stk.	,,	4	Continental Union, Ltd.	80–83	..	4 16 5
200,000	,,	,,	7	Do. 7 p.c. Pref.	124–126	..	5 11 1
492,270	Stk.	—	5½	Derby Con. Stk.	124–125	..	4 12 0
55,000	,,	—	4	Do. Deb. Stk.	103–105	..	3 16 2
1,002,180	10	Jan. 16	10	European, Ltd.	17½–18½	..	5 8 1
16,415,840	Stk.	Feb. 13	1/17/4	Gas-light and Coke | 4 p.c. Ord. | 3½ p.c. max.	102–104	+2½	4 13 7
2,600,000	,,	,,	3½		75–78	..	4 9 9
4,062,235	,,	,,	4	and Coke | 4 p.c. Con. Pref. | 3 p.c. Con. Deb.	95–98	..	4 1 8
4,674,850	,,	June 13	3		71½–73½	..	4 1 8
258,740	Stk.	Mar. 13	5	Hastings & St. L. 3½ p.c.	89–91	..	5 9 11
82,500	,,	,,	6½	Do. do. 5 p.c.	—	—	—
70,000	10	April 25	11	Hongkong & China, Ltd.	17–17½	..	6 5 9
131,000	Stk.	Mar. 13	7⅞	Ilford A and C	152–155	..	4 18 4
65,780	,,	,,	6⅛	Do. B	120–122	..	5 0 5
65,500	,,	June 27	4	Do. 4 p.c. Deb.	87–89	..	4 9 11
4,940,000	Stk.	May 16	9	Imperial Continental	162–167	..	5 7 9
1,235,000	Stk.	Feb. 13	3½	Do. 3½ p.c. Deb. Red.	85–87	..	4 0 6
200,242	Stk.	Mar. 13	6	Lea Bridge Ord. 5 p.c.	120–123	..	4 17 7
561,000	Stk.	Feb. 27	10	Liverpool United A	208½–210½	..	4 15 0
718,100	,,	,,	7	Do. B	149–151	..	4 12 9
806,083	,,	June 27	4	Do. Deb. Stk.	96–98	..	4 1 8
63,480	Stk.	June 27	3	Maidstone 3 p.c. Deb.	66½–68½	..	4 7 7
75,000	5	June 13	6	Malta & Mediterranean	4⅜–4⅝	..	6 3 1
250,000	100	April 1	4½	Met. of Melbourne | 4½ p.c. Deb.	98–100	..	4 10 0
541,920	20	May 30	4	Monte Video, Ltd.	12½–13	..	6 3 1
1,775,892	Stk.	Feb. 27	4½	Newc'tle&G'tesh'd Con.	98½–99½	+½	4 10 6
529,705	Stk.	June 27	3½	Do. 3½ p.c. Deb.	83½–84½	..	4 2 10
55,940	10	Feb. 27	7/7/0	North Middlesex 7 p.c.	13–14	..	5 4 7
300,000	Stk.	May 16	8	Oriental, Ltd.	124–129	..	6 4 0
60,000	5	Mar. 28	10	Ottoman, Ltd.	8¼–8⅝	..	5 14 3
60,000	50	Feb. 27	13	Portsea, Island B	125–128	..	5 1 7
100,000	50	,,	12	Do. C	122–125	..	4 16 0
249,980	5	May 16	8	Primitiva Ord.	5⅝–6⅛	..	6 8 0
499,960	5	June 27	5	,, 5 p.c. Pref.	4⅛–5⅛	+⅛	4 17 7
521,600	100	June 2	4	,, 4 p.c. Deb.	93–95	..	4 4 3
346,198	Stk.	June 27	4	River Plate 4 p.c. Deb.	90–92	..	4 7 0
275,000	5	Apl. 11	12	San Paulo, Ltd.	—	..	—
150,000	10	,,	6	Do. 6 p.c. Pref.	11½–11⅞	..	5 2 2
125,000	50	July 1	5	Do. 5 p.c. Deb.	48–50	..	5 0 0
135,000	Stk.	Mar. 13	10	Sheffield A	225–227	..	4 8 1
209,984	,,	,,	10	Do. B	225–227	..	4 8 1
523,500	,,	,,	10	Do. C	224–226	..	4 8 6
90,000	10	May 30	7½	South African	9½–10½	..	7 2 10
6,429,895	Stk.	Feb. 13	5/9/4	South Met., 4 p.c. Ord.	109½–111½	+1½	4 18 0
1,895,445	,,	July 11	3	Do. 3 p.c. Deb.	71⅓–73⅓*	..	4 1 8
209,830	Stk.	Feb. 27	8½	South Shields Con. Stk.	161–163	..	5 4 4
952,795	Stk.	Feb. 27	6	S'th Suburb'n Ord. 5 p.c.	117–119	..	5 0 10
60,000	,,	,,	5	Do. 5 p.c. Pref.	115–117	..	4 5 6
117,058	,,	June 27	5	Do. 5 p.c. Deb. Stk.	115–117	..	4 5 6
594,740	Stk.	May 16	5	Southampton Ord.	102–105	..	4 15 3
120,000	Stk.	Feb. 13	7⅜†	Tottenham and Edmonton | A 5 p.c. | B 3½ p.c. | 4 p.c. Deb.	139–142	..	5 3 10
483,940	,,	,,	5⅞†		115–117	..	5 0 5
149,470	,,	June 27	4		90–92	..	4 7 0
182,380	10	,,	5	Tuscan, Ltd.	5–6	..	8 6 8
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	94–96	..	5 4 2
286,476	Stk.	Feb. 27	5	Tynemouth, 5 p.c. max.	114–115	..	4 6 11
30,000	Stk.	..	..	Wandsworth, Wimbledon, and Epsom—Wandsworth A 5 p.c.	160–165	..	—
255,636	,,	..	..	,, B 3½ p.c.	132–137	..	—
108,075	,,	..	..	,, C 3½ p.c.	113–118	..	—
352,000	,,	..	..	Wimbledon 5 p.c.	110–115	..	—
88,000	,,	..	..	Epsom 5 p.c.	117–122	..	—
88,416	,,	June 27	3	3 p.c. Deb. Stk.	68–70	..	4 5 9

Prices marked * are "Ex-Div." † Next Dividend will be at this rate.